amateur radio

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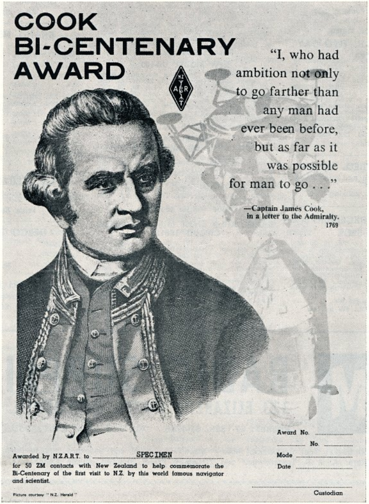

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amateur radio

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COVER STORY

Reproduction of New Zealand's ZM Cook Bi-Centenary Certificate. Details of this award were published in "A.R.," November 1969, page 24.

World Administrative Radio Communications Conference for Space Telecommunications

As has previously been announced in "Amateur Radio," the International Telecommunications Union has called a World Administrative Radio Communication Conference for Space Telecommunications, to open in Geneva in June 1971 with a maximum duration of seven weeks.

Who better to comment on the significance of this Conference than Mr. R. E. Butler, the Deputy Secretary-General of the I.T.U. On 15th September 1969, Mr. Butler addressed the I.T.U. (C.C.I.R.) Study Group IV. (Space Telecommunications) at Geneva. He said: "Personally, I believe, and I think that many will agree, that this will be one of the most important radio-communication conferences ever held by the Union—ranking in importance to the 1947 Atlantic City Conference—for the profound influence it will have on future frequency service allocations, including sharing and the recognition to be given to the incentives that will arise for the maximum exploitation of satellite capacity and orbits, as well as the determination of the necessary co-ordination procedures at the various international levels—more important, say, than the 1963 Space Conference, when much attention was being focused on the public telecommunication and research needs and different orbital considerations."

There is no doubt that the I.T.U. appreciates the role that can be played by the Amateur Service in space communications. Three days earlier, on 12th September, Mr. Butler opened the International Amateur Radio Convention held at Geneva. Again, I quote from his words: ". . . I think that world communications and international communication and co-operation have a tremendous debt to Radio Amateurs. You all have always been to the forefront of developing co-operation, and providing the back-up assistance in time of stress; and here I speak from practical experience from my country [Australia], that from time to time is ravaged by the climatic disturbances and national disasters in the way of floods and fires at country and near country centres. On many occasions, normal telecommunications have been severed and great reliance has been placed in the provision of advice and guidance to the people in the more difficult areas through the use of the 'ham operators'. Their proficiency has been the foundation of many community service requirements. Such are the contributions of the Amateur Radio operator which go on almost unnoticed but quite successfully.

"If I turn to another aspect, we hear a great deal these days on the developments of global communication systems, specially in the use of satellites. Again, almost unnoticed, with their much less elaborate plans, the Amateurs have again shown their energy in being to the forefront. You have organised your own satellite experiments, which gave the possibility of many Amateurs joining in the use of this new technology. With the orbits which were selected, there have been more or less global use of the satellites.

". . . as the I.T.U. faces its responsibilities, it is pleasing to know that we can still rely on the contribution of the Amateurs towards the achievement of our basic and mutual objectives."

The Federal Executive is very alive to the significance of the 1971 Space Frequencies Conference. Whilst the planning at a governmental level for that Conference is at its very earliest stages, it is most important that the Amateur Service is fully prepared to meet the challenge of that Conference. Already, preliminary discussions have taken place with our Administration, but the problem is global, not national, and therefore, the Executive has been engaged in considerable correspondence with its fellow I.A.R.U. Member Societies overseas.

One of the great issues for the Amateur Service at this Conference is the right of the Amateur Service to have the unrestricted privilege of using its frequency allocations for space communications. No doubt other issues will emerge, but at this time to predict what these issues will be would be mere speculation. The question of frequency allocations must loom large. The position is complicated by the fact in the allocations above the 144-148 MHz. allocation, the Amateur Service allocations are shared bands with the Amateur Service as the secondary user.

At this stage, the Administrations are preparing for the Conference by preparing their own proposals which are collated by the I.T.U. Headquarters at Geneva, and are circulated throughout the world for consideration by all Administrations.

How important to the Amateur Service are the v.h.f. and higher frequency allocations? I suppose if one attempted to answer this question on the basis of band usage, one would inevitably be drawn to the conclusion that these bands are not terribly important, but this is to be short sighted in the extreme. The Amateur Service is only just beginning to move into these higher allocations, as techniques and components become more readily available. To date they have primarily been the province of the serious experimenter. There is no doubt that satellite communications will offer increasingly wide horizons for the Amateur Service generally.

The Amateur Service cannot afford to suffer any frequency loss, for it is the potential use of these bands in the future, using techniques that may require significant bandwidth, that is the corner stone of the Amateur Service's case. The loss of frequency now may not seem to be terribly important, but in the future, such a loss may turn out to be an irretrievable tragedy.

The Wireless Institute of Australia will formulate its policy towards the World Administrative Radio Communication Conference for Space Telecommunications at the Federal Convention to be held at Easter this year. The Federal Executive has prepared for the consideration of Federal Councillors a detailed comprehensive and confidential report.

As an organisation, we cannot afford not to be prepared—and we shall be prepared.

—MICHAEL OWEN, VK3KI,
Federal President, W.I.A.

LONG-DELAYED ECHOES . . . RADIO'S "FLYING SAUCER" EFFECT*

BY O. G. VILLARD, JNR., W6QYT; C. R. GRAF, W5LFM; AND J. M. LOMASNEY, WA6NIL

HAVE you ever had the experience of hearing your own voice repeat the last couple of words of your transmission, after you have switched over to receive? Or have you been aware, after another station stands by, that a weaker signal on the same frequency is repeating the last few words of the transmission, with exactly the same "fist"?

Well, believe it or not, some Amateurs have. If you, dear reader, think us out of our minds to even bring this matter up, rest assured that there are many others who share your view and would cheerfully consign us to the booby hatch. If you haven't tuned out by now, you are undoubtedly asking: just who **are** the folk who have had this experience? Are they emotionally unstable types, prone to LSD-style hallucinations? But hear this: one is a professor of mathematics at a well known West Coast university; another is a physicist at a midwest research foundation; still another has managerial responsibility for important communication satellite programmes at a prominent West Coast aerospace corporation, and most of the rest have a professional connection with electronics in some way . . .

Hard to discount their reports, it appears. Were these men hoaxed, you ask? That's always a possibility, and it apparently has happened in the past. But what about the instances where the echo was heard **both** on the Ham's own signal, **and** on the signal of the station being worked? It would take a pretty clever spoof to simulate both the sound of long-distance transmission and the transmit-receive timing. Still, it could be done, just as a photograph of a flying saucer can be handily simulated with the aid of ordinary crockery.

That's what makes the study of long-delay echoes (LDEs) exciting. At the moment, there is no really indisputable proof that they exist. Scientists remain unconvinced about UFOs, and LDEs are in the same category. However, an increasing body of experimental evidence argues for the reality of LDEs, and it is interesting that a number of new ideas for possible theoretical explanations have come to light only within the last couple of years.

Scientific research is placed under great handicaps when the effect being studied is highly infrequent in occurrence. The handicap is even worse when there is no satisfactory theory to guide experimentation. In these circumstances it hardly pays to set up a special test if a useful result is achieved only once a year on the average. This problem is well known to astronomers, who depend almost entirely on Amateur

● Amateur help is needed in unravelling the mystery of signal "echoes" which persist for times much longer than round-the-world propagation delays. This baffling and unexplained effect, wherein whole words—and not just syllables—are repeated, was first reported in 1928, and occurs so rarely that many doubt its reality. Interest in the subject has been re-awakened by recent discoveries in plasma physics which—if applied to the ionosphere—suggest new possible explanations. The authors review the reports known to them, suggest that the effect is real, and solicit further observations.

reports to locate comets which pop into view in unannounced places and at unannounced times. Busy professionals simply cannot devote that many hours per year to scanning the skies. LDEs provide an analogous opportunity for Hams to be of service to the professional community. Reports on LDEs, with time logged accurately, should be invaluable in helping to solve this particular puzzle.

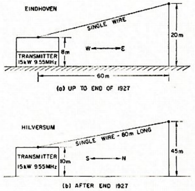


Fig. 1.—Details of the transmitting set-ups used for the first observations of long-delayed echoes.

BACKGROUND

Echoes of very long delay were first reported in 1928 (References 1 and 2), not long after international short-wave broadcasting got under way. Transmitter powers were around ten kilowatts; antennas were tilted wire (see Fig. 1); the radio frequency used was around ten megacycles, and receivers were for the most part regenerative. Oscilloscopes and tape recorders were unheard of. On the other hand, interference levels were far below those of today. The experiment consisted of transmitting one or more dots or dashes, and timing the received signals with the aid of a stop watch. Delays ranged from 2 to 30 seconds. Echoes were heard at locations both close to and distant from the transmitter, sometimes apparently at the same time. Fig. 2 shows an example.

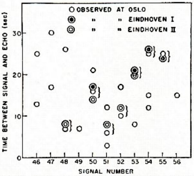


Fig. 2.—Some early observations of long-delayed echoes, some of which were apparently audible at three locations at the same time. Signals were sent every 30 seconds; note the briefness of the total period of reception. (From Reference 2)

A number of theories in explanation of the observations were tried and discarded. The basic difficulty is that radio waves in most circumstances travel at the velocity of light (186,000 miles per second), so that a complete transit of the earth takes only one-seventh of a second. A trip to the moon and back takes roughly two seconds. One theory held that the waves might be slowed down sufficiently if they happened to be close to the ionospheric "critical frequency"; however, it soon became obvious that the accompanying losses would inevitably swallow them up. Loss also makes the possibility of multiple passes around the earth unlikely (210 are required for a 30-second delay)—for the ionospheric gas is by its very nature a lossy dielectric. The hypothesis that echoes might be returned from uncharted clouds of electrons far distant from the earth was seriously considered at the time; today, of course, we know that deep space holds no surprises of that particular sort.

By the middle 1930s few echoes were being received, and the matter remained dormant until the Cavendish Laboratory of Cambridge University undertook a study in 1948 (Reference 3). In a careful year-long test involving transmission of about 27,000 test signals at 13.4 and 20.6 MHz., not one LDE was recorded. No further published scientific activity seems to have taken place since that time.

* Reprinted from "QST," May 1969

In the intervening years there appears to have been at least one Amateur report which was discovered to be a hoax, and in another instance a mechanical fault in a recording was responsible for reports of "delayed echoes" audible on a standard-frequency-station time announcement.

In scientific work when none of the postulated explanations satisfactorily explains a reported effect, and when a reputable scientific organisation attempts to find it experimentally and doesn't succeed, there is an understandable and almost overpowering impulse on the part of other members of the scientific fraternity **not** to become further involved. This is how LDEs came to have roughly the same dubious status as UFOs.

Some 18 of the type 3 events were observed in a period of about a year. These findings were reported to the Office of Naval Research under whose contract the work was performed, but they were never published because it could not be proved beyond reasonable doubt that the observed signals were in reality caused by WWV transmissions. They could, for example, have been the result of an obscure fault in the transmitter, although this is considered highly unlikely. WWV frequencies are shared by other standard-frequency stations throughout the world; this introduces troublesome uncertainty. (So does harmonic radiation from 100 KHz. crystal oscillators on the Hewlett-Packard Palo Alto production line, as WB6FDV found out in a classic bit of detective work.) A more sophisticated experiment was clearly needed to decide the matter one way or another, and the effort was side-tracked owing to the pressure of other activities.

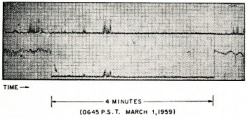


Fig. 3. — Signal-intensity-versus-time recording for normal conditions. Upper channel is background noise 30 KHz. away. Lower channel is standby of WWV-20 carrier. Note rapid drop into background noise level. Receiver bandwidth: 100 Hz.

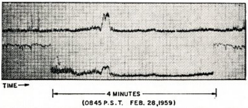


Fig. 4.—Note the weak signal persisting on the WWV-20 frequency for roughly 30 seconds after standby. There is no proof, but it **might** be long-delayed echo energy.

MORE RECENT EXPERIMENTS

In 1958, W5LFM drew W6QYT's attention to field-strength recordings in which there was an apparent decay of received-signal energy during the 30-second interval of carrier interruption for identification purposes. This behaviour, which **could** have been ascribed to weak (perhaps incoherent) long-delayed echo energy, turned out in the end to be due to the effect of mechanical "stiction" on operation of the pens of the then-standard Esterline-Angus paper-chart recorders. The observation did, however, suggest an inexpensive means for collecting data on possible LDEs: use a more suitable recorder and see what is left behind on the frequency when WWV's carriers leave the air once an hour. Studies of this sort were made by W6QYT with the help of various part-time graduate-student assistants at Stanford University in the period 1958-1960 (Reference 4). The following suspicious circumstances were — very occasionally — noted:

(1) Extra noise, decaying exponentially for tens of seconds;

(2) Extra noise of roughly constant intensity, enduring for about the same period of time (see Figs. 3 and 4), and

(3) Instances where the same noise actually contained a weak signal similar to the WWV carrier. (An example is shown in Fig. 5.)

POSSIBLE THEORETICAL EXPLANATIONS

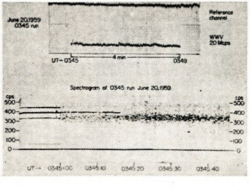
If h.f. signals are to endure for tens of seconds, a way must be found for ionospheric loss to be overcome. In the 1930s the possibility of signal amplification in the ionosphere had not occurred to anyone, but today we can visualise a number of means by which this might take place. Parametric amplification has been suggested (Reference 5): the ionosphere is not a perfect linear dielectric, and if we could exploit this property, one signal —in principle—could "pump" another.

Another new development is maser amplification; the ionospheric plasma is acted upon by a whole spectrum of radiation from the sun; is it possible that amplification-producing population inversion somehow takes place? Still another explanation has to do with signal storage in the ordered motion of electrons spinning around magnetic field lines; for example, there might be an ionospheric analogue of the phenomenon of spin echoes in nuclear magnetic resonance.

Professor F. W. Crawford of Stanford University has been studying—on paper and in the laboratory—plasmas that "talk back", almost like Edison's original phonograph (Reference 6). A complex signal is fed in, which then disappears insofar as the external circuit is concerned. To call it out, the plasma is pulsed; a replica **reversed in time** then appears (see Fig. 6). These "plasmas with memory"—and the above is only one scheme of many—are most readily studied when comparatively high pressures and gigahertz radio frequencies are used. The tantalising feature of these experiments is that if they **could** be extended to ionospheric pressures and h.f. frequencies, the indicated time delays fall right in the 3-30 second ball park.

Another remarkable and comparatively recent finding is the so-called "stimulated natural emission" observable at v.l.f. At very low frequencies (on the order of 15 KHz.), radio signals both travel underneath the ionosphere and penetrate it. Those which penetrate are guided by the magnetic field lines and travel from northern to southern hemispheres at phenomenally high altitudes over the equator (one or two earth radii). During their travel, these waves actually rearrange the ambient electrons and store energy in them. This energy is available to amplify any signals of the same frequency after the causative wave is shut off. As a result, an unstable but recognisable replica of the signal is heard after the original transmission stops. Examples are shown in Fig. 7, which is taken from Reference 7. This mechanism most emphatically will **not** work at h.f., since

Fig. 5.—Lower record (a frequency-amplitude-time plot) shows possible 15-second "echo" of WWV-20 transmission. (Note the 60 Hz. hum side frequencies on the WWV carrier prior to standby.) There is no **proof** that this signal was really related to the WWV transmission; only a presumption based on observation of a large number of records of this type.



the circumstances are then wholly different. But the fact that radio signal amplication in the ionosphere can happen at all, makes the possibility that something analogous might happen at h.f. seem more likely.

These new developments in the understanding of plasmas stimulated W6QYT to ask for reports of LDEs at a recent get-together of the Northern and Southern California DX Clubs; to his surprise five excellent ones were received; they are included in the summary following.

W5LFM, who has also been interested in this subject since 1958, has collected reports from W5VY and W5LUU, and has himself observed a difficult-to-explain half-second time delay on the time ticks of a Russian standard-frequency station.

SUMMARY OF LDE REPORTS

Date	Call	Band MHz.	Approx. Duration Seconds	Time, GMT	Phone/ CW	Audible on Own/Other
Oct. 16, 1932	W6ADP	28	18	≈1800	CW	Own
Winter, 1950-51	W5LUU	7	5	≈0300	CW	Own
Winter, 1965	K6EV	14	3–4	0600-0700	SSB	Own
Dec. 2, 1967	W5VY	28	3	1328	SSB	Own
Jan. 27, 1968	W5LFM	10	½	1400-1430	Time Ticks	Station RID
Dec. 18, 1968	W6KPC	28	1	≈2000	SSB	Other
Jan. 21, 1969	W6OL	14	6–10	1536	CW	Other
Feb. 17, 1969	K6CAZ	2	≈2	1430-1500	SSB	Own and Other

SUMMARY OF CHARACTERISTICS

The Stanford recordings suggested—but did not prove—that incoherent noise "echoes" may exist, as well as coherent ones containing a replica of the signal. The Amateur and the early reports, of course, deal only with the coherent variety, which seem to be appreciably less frequent in occurrence. Following is a summary of the conclusions which can be derived from the Amateur reports taken as a group:

(1) Multiple-second "coherent" signal echoes, either phone or c.w., appear to be real, and are observable for short periods of time at highly infrequent intervals.

(2) They are audible both on a station's own signals, and on signals of other stations.

(3) They have been observed at 7, 14, 21 and 28 MHz., but apparently not at higher frequencies.

(4) They either occur most frequently (or perhaps are most easily heard) when a given band is just "opening up"—i.e. when skywave propagation to some point on earth is just becoming possible.

(5) They seem to be audible when long-distance propagation is good and when geomagnetic activity is low. (The presence of long-path as well as short-path propagation, or signals from stations at antipodal locations, is apparently a good omen.)

(6) Stations reporting LDEs typically have been ones having antennas well up in the air, at locations reasonably good for DX, but other than that no exceptional facilities seem to be required.

(7) An active Ham who DXes one or two hours a day, may expect to hear an LDE once a year, on the average.

(8) The LDEs appear to be one single echo, rather than several successive ones.

(9) No Doppler shift is perceptible.

(10) The sound of the echo resembles that of a DX signal (i.e. it apparently involves long-distance multipath propagation).

(11) The strength is usually weak, although some reports have put it as S3 or more.

(12) Echo strength always decays with time, rather than the other way around.

(13) The total time interval during which the echo effect can be heard is remarkably short—usually no more than a few minutes.

(14) There is some indication that LDEs may be heard more frequently on signals which have travelled through the northern and southern auroral zones.

A COMPARISON

It isn't clear that the currently-observed effect is the same thing as was reported in the 1930s, since the early accounts all stressed a multiplicity of signals returned for a single outgoing pulse. But a connection is certainly possible.

It is interesting to compare the circumstances of the experiments of those times with those of today. The early work involved high transmitter power (10 kw. or so), relatively non-directional antennas (tilted wires) radiating upward as well as outward, frequencies of the order of 10 MHz., and comparatively short-distance propagation. Today's observations were performed with lower power, higher beam gain, higher frequencies, antennas directing their energy closer to the horizon, and long-distance propagation.

As the Cambridge group (Reference 3) pointed out, perhaps the most significant difference between "then" and "now" is the greater crowding of the

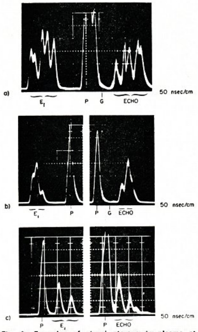


Fig. 6.—Examples of signal storage in plasma at microwave frequencies. Above are plots of amplitude versus time (from left to right). The signals marked E1 are the inputs, which are stored; the readouts are the replicas designated "echo", which require for their release application of the pulses "P". (Photo courtesy of Professor F. W. Crawford)

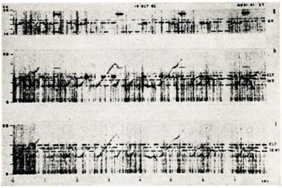


Fig. 7.—Artificially stimulated natural emissions (similar to "echoes") at v.l.f., shown here as a matter of interest only. Uppermost spectrogram shows v.l.f. spectrum as received near the transmitters; NAA is the lowest frequency signal, at 14.7 KHz. Lower two records, taken aboard the USNS Eltanin in the Antarctic, show diagonal emissions growing out of NAA dashes. Energy stored in the magnetosphere while NAA is transmitting, is released in the form of unstable, partly coherent radio signals. Note: this particular mechanism does not work at h.f.; however, it is conceivable that something analogous might. (From Reference 7)

h.f. spectrum. In their view their lack of results might in part be explained by the difficulty of finding a clear channel. It is certainly true that they operated in commercial telegraphy bands, which are comparatively crowded; it is also true that their antennas were directive upward, since they were primarily looking for reflections from electron clouds in space. It is also possible to speculate that, if maser amplification were involved, interference would have the effect of syphoning off amplifying power which might otherwise go into keeping the echo going. (This would be in addition to the obscuring effect of the interference.) The QRM would tend to be amplified, instead of the echo, since stimulated electrons in giving up their energy will tend to look themselves to the strongest signals of the appropriate frequency present at any given time.

WHAT AMATEURS CAN DO TO HELP

Additional Amateur reports of LDEs are urgently needed to guide on-going research. If an LDE **is** experienced, the most important single piece of information to write down is the exact time of occurrence. Because LDEs are so transistory, it may be possible to establish a relationship to other, equally transistory geophysical events simply by making a time-of-occurence comparison. Try to log, **at the time**, all the circumstances of the experimental set-up—frequency, antenna heading, etc., plus a careful description of the observed effect.

It is suggested that the making of special transmissions in the hope of catching an LDE is a sure road to total frustration. Best bet is to act as if they didn't exist. However, if you have a tape recorder which can be spared from other duty, use it to record the output of the station receiver at all times. A single tape can be used over and over again. Then, should an echo put in an appearance, you'll have it trapped—if the tape hasn't worn out in the meantime! Frequency-amplitude-time plots (similar to "voice prints"), made from such recordings, should be very instructive. However, tapes (like photos of UFOs) can be easily faked, so don't expect to convince skeptical scientists and garner instant glory by producing a single example: nobody will bite. Nevertheless, many tapes collected over a period of time at many locations, and containing internally consistent information, may well permit the piecing together of a sensible explanation.

It's fun to think that in this era of "big" science, there is still an era where Amateur Radio operators can make contributions which will be as uniquely valuable as those provided to astronomers by the amateur comet-watchers.

SOME REACTIONS UPON HEARING LDEs

Those who are privileged to hear LDEs are clearly members of a highly exclusive club, since many Amateurs active for 20 years or more have never observed anything like it. Yet some who do, such as W5VY and W6CAZ,

Please send reports to—
W6QYT,
Radioscience Laboratory,
Stanford University,
Stanford, California, 94305.
All communications will be acknowledged and credit given.

report that they hear LDEs on the average about once a year when they are operating regularly (perhaps 1-2 hours per day on the average). Hence, the effect must happen at least this often.

W6QYT has queried ship-to-shore radio-telegraph operators of the Mackay Radio receiving site at Half Moon Bay, California, with negative results. It appears that these men, who contact ships at varying distances throughout the world, every day, around the clock, and in several wavebands, simply do not hear LDEs. However, a typical ship transmitter has a power in the order of 150 watts, and a non-directional antenna; hence it is not as potent as most Amateur stations.

Psychologists say that the human mental computer is astonishingly efficient at recognising something which is known. This is probably an important aspect in the identification of one's own voice or "fist". One wonders how many weak LDEs associated with other transmissions may have gone unnoticed, because the ear tends to shut out—automatically—anything it classes as QRM, and therefore spurious.

The almost universal reaction to hearing a good LDE is total astonishment. For this reason the memory tends to be fresh even after the passage of years. Some of the reports convey this feeling quite dramatically. According to W6OL, "I was just tuning the band, listening, and heard this Russian working someone. There was some slight QRM on his transmission but the copy was reasonably good. However, I heard him sign and then I realised that the QRM was his echo, and that I could again copy the last part of the transmission." Says W6KPC, who heard "whole words, if they were not too long, . . . the echo was so loud, long, and startling that my reaction was to 'talk' about it with someone! . . . I've never heard such long echoes before or since." In W6ADP's words, "I was calling ON4AU on 28 MHz., and switched over to listen and heard on my own frequency ON4AU de W6ADP K. Was very weird and never will forget it. Signal sounded like it was coming a long way but was S6 or so."

ACKNOWLEDGMENT

The assistance of Professor B. Dueno, KP4HF, is gratefully acknowledged. Members of the staff of WWV and WWVH have provided useful information. Measurements at Stanford University were supported in part by the Office of Naval Research under contracts Nonr-225 (24) and Nonr-225(64).

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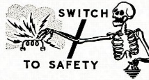

ELECTRIC CURRENT AND OHMS LAW

LECTURES TWO AND THREE

C. A. CULLINAN, VK3AXU*

ELECTRIC CURRENT

In some atoms, notably silver and copper, the outer electrons can be replaced by other electrons and thus move from atom to atom. This constitutes a flow of electric current.

Current is measured in Amperes, after its discoverer, Ampere.

TERMS

Ampere

Milli-ampere = one-thousandth of an ampere
= 1×10^{-3} ampere.

Micro-ampere = one-millionth of an ampere
= 1×10^{-6} ampere.

Resistance.—In some atoms, the electrons are very difficult to move, so it becomes very hard to pass an electric current. Such atoms or molecules are known as insulators.

The unit of resistance is the Ohm, named after Ohm.

Ohm

Megohm = one million ohms
= 1×10^{6} ohms.

Milliohm = one-thousandth of an ohm
= 1×10^{-3} ohm.

1 ohm is the resistance of a column of mercury at 0°C., having a uniform cross section, a height of 106.3 cm. and weighing 14.452 grammes.

E.M.F.—Electromotive Force, also known as electrical pressure or voltage. It is the electrical force or pressure between two points. It is usually called Volt after Volta.

Volt

Megavolt = one million volts
= 1×10^{6} volts.

Kilovolt = 1 thousand volts
= 1×10^{3} volts.

Millivolt = one-thousandth of a volt
= 1×10^{-3} volt.

Microvolt = one-millionth of a volt
= 1×10^{-6} volt.

MeV.—The unit of energy applied to the radio active emission of particles or similar radiation. Not to be confused with electro-magnetic radiation.

MeV = about one-millionth of an erg = 1 million electron volts.

1 erg = work done in moving a mass of 1 gramme a distance of 1 centimeter.

The term MeV should not enter the course.

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● Continuing the series of lectures by C. A. Cullinan, VK3AXU, at Broadcast Station 3CS for students studying for a P.M.G. Radio Operator's Certificate.

OHMS LAW

This is a fundamental law of electricity and must be completely memorised:

$$\text{Current} = \frac{\text{E.M.F.}}{\text{Resistance}}$$

This is usually written:

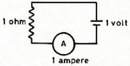
C = E ÷ R, where C is current in amperes (sometimes known as I).

E = E.M.F. (voltage) or pressure or volts.

R = resistance in ohms.

In A.C. calculation, R is known as Z, the symbol of Impedance.

One ampere is the current which will flow in a resistance of 1 ohm when an E.M.F. of 1 volt is applied.



Transposing:

C = E ÷ R
E = C × R
R = E ÷ C.

Power.—This is expressed in the unit Watt.

KW or Kw = 1 kilowatt = 1,000 watts.

Mw = 1 megawatt = 1,000,000 watts (used mainly in electrical power systems). Do not confuse with radio term of:

mW = 1 milliwatt = one-thousandth of a watt = 1×10^{-3} watt.

The watt is a unit of power. The watt-hour is a unit of energy.

Suppose a power station can produce 100,000 Kw. and it operates continuously for one year. Then the energy it will have produced

= 100,000 × 8760 KWH (kilowatt hours), as there are 8760 hours in a normal year.

= 876,000,000 kilowatt hours.

= 876 megawatt hours.

RESISTANCE

When two or more resistances are connected in **series**, the total resistance is the sum of the individual resistances. However, when two or more resistances are connected in **parallel** the resultant resistance is less than the smallest, as determined by the formula known as the Reciprocal of the Reciprocals.

$$R\ \text{total} = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{RN}}$$

The following problem will illustrate both the calculations of resistances in series and resistances in parallel (shunt).

Problem

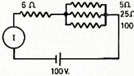
In the following circuit, find:

(1) The voltage drop across each resistance.

(2) Current in each resistance.

(3) Total current in the circuit.

It is assumed that the battery has zero internal resistance.



A. The simplest way to tackle this problem is to find, firstly, the total current, because when this is known all the other answers can be derived from Ohms Law.

B. Ohms Law states C = E ÷ R. Therefore to find the total, it is necessary to find the total resistance of the circuit, therefore we have to calculate the effective resistance of the three parallel resistances and add this value to the 6 ohms series resistance R1.

$$R\ (\text{parallel}) = \frac{1}{\frac{1}{R2} + \frac{1}{R3} + \frac{R4}{1}}$$

$$= \frac{1}{\frac{1}{5} + \frac{1}{25} + \frac{1}{100}}$$

Find LCM = 100.

$$= \frac{1}{\frac{\frac{1}{5} + \frac{1}{25} + \frac{1}{100}}{100}}$$

$$= \frac{1}{\frac{20 + 4 + 1}{100}}$$

$$= \frac{1}{\frac{25}{100}}$$

Remove reciprocal. Invert bottom term.

$$\text{Therefore R (parallel)} = \frac{100}{25}$$

$$= 4\ \text{ohms.}$$

(Continued on Page 13)

Commonsense and Instabilities in Transistorised Transmitters

R. LEO GUNTHER, VK7RG*

"To be a follower of fashion is not always a wise choice."
—G3VA in "Technical Topics," "Radio Communications," Jan. 1969

Although the above quotation was in reference to the illusion that s.s.b. bears charismatic virtue compared to n.b.f.m., it could well be applied to the modern myth that transistors can replace valves in just about anything, including transmitters. The past five years of writing about semiconductors in the Australian "E.E.B." may have established me as a firm advocate of semiconductors. If so, I believe that I ought to be able to point out some of their limitations. The point of this article will be to show that if transistors are used at r.f. in transmitters, they must be used properly, and that if this is too difficult, valves could well be a better choice!

DIRE PRECAUTIONS

For some two years I have been filling the pages of "E.E.B." with a series of articles on the design of transistorised transmitters, pointing out that there are certain unique limitations of voltage, linearity, and frequency which must be considered if the beasts are to behave properly.

For this, I have acquired a certain reputation as a prophet of Doom. I do not think, however, you could accuse the author of "Technical Topics" and of "Amateur Radio Techniques" (by R.S.G.B.) of a lack of technological insight, yet he makes much the same points in his columns in "Radio Communication"—for example in Feb. 1968, p. 103: "Transistor Transmitter Instabilities" and "High Power Transistor P.A's."

He points out that most troubles arise when the transmitter is detuned, and particularly when loads are reactive—and when does this not occur in Amateur practice? To my surprise, paralleled transistors are more efficient than in push-pull, but only if they share current equally, as via separate base drive adjustment—and when is this ever done in Amateur transmitters?

Many of the same points are raised in the excellent R.C.A. "Silicon Power Circuits Manual," and in numerous other places. And for every chap who writes to say that his transmitter works fine without all that fuss, there are two or three who complain that transistors are untameable, often expensively so. Their transistors have perished from overdrive, overvoltage, inexplainable and ineradicable parasitics, or from heat death (inefficient operation or unequal current sharing).

Even worse are the numerous experimenters who are content if they can merely get a lamp to light at the output, or who have parasitics creeping out from every condenser, but who prune them by careful glue and whitewash, and by efficiencies which rarely represent Q over 5. And their harmonic outputs?

Yes "it will work," but so will a spark coil; many of the contemporary results are as appalling as the signal from a spark coil—and nearly as broad. They arise from the assumption that "transistors are just like valves." Well, they are not, they're different. And the difference becomes more pronounced as the power goes up. And if you are going to get good results from them, it requires a few simple precautions, frequently found in the now readily-available literature on the subject.

ON MAKING EFFICIENCIES

The following article, disguised as a review of some interesting literature, will lay stress on three main points:

(1) Instabilities must not be tolerated. These include oscillation, or tendency to oscillation of an amplifier at **any** frequency.

(2) Efficiency must be reasonable, both for coupling and for output. This involves suitable impedance matching, and it involves a judicious choice of collector conduction angle **and** tank Q (Ref. 1-4).

(3) There is no need to use transistors as a matter of fashion. In those instances where valves can do a better job, valves will do a better job, simpler, cheaper, and easier. Such an instance arises in many applications which require more than a few watts of power at r.f.

Yes, certainly valves have filaments "which soak up power". So do transistors and coils as often used. But, to achieve efficiency with the semiconductor you must sacrifice reliability; not so with the lowly valve.

I must mention here that in the following discussion I am not necessarily exhorting you to read the articles (unless, of course, you become interested in looking them up), but merely to think about the points raised, and apply them to your own experience. This will make it unnecessary to reproduce any diagrams here. If you don't remember what a neutralised amplifier looks like, look it up. The recently published "Radio Communication Handbook" by R.S.G.B. is a fine source for much relevant information.

AN ILLUMINATING ARTICLE

A good framework around which to mould the first point would be: "A 1969 Model 50 Mc. Transistor Transceiver," by T. H. Campbell, WA7FJC, "QST," Jan. 1969.

In addition to a very interesting transmitter, a first class receiver is described, using, among other things, the cascoded triode configuration of triode FETs (Ref. 9) in the r.f. and i.f. stages (and why not the mixer?).

INTERCHANGEABILITY OF POWER TRANSISTORS

There are various transistor types specified for his transmitter, but in my opinion you need not be concerned about "exact equivalents" for such things. The main requirement is to use P_c and f_T ratings (Ref. 10-12) appropriate for your needs. For this 50 Mc. transmitter, the 2N2217 in the final has P_c = 800 mW. maximum, f_T > 250 Mc. The Fairchild 2N3642 or Motorola 2N3137 would do the same thing, the AY6102 at perhaps less collector current, the Motorola 2N697 at one-fourth the frequency. For higher power (or more efficiency at the same power!), the R.C.A. 2N3375 or 2N3866, or Mullard BLY34, 2N3553, or 2N3375 would be worth using. Much of the concern about interchangeability is groundless. Many transistors are more alike than the detailed specification sheets might lead you to believe. (Ref. 12, 13.)

INPUT AND DRIVE

An excellent rule of thumb mentioned by WA7FJC is to limit the total collector d.c. input to the amplifier to the maximum dissipation rating of the transistor. This provides a generous and often necessary safety factor. Driving stages are no problem: drive the final until the desired collector current is obtained under load, with due respect for base-voltage ratings, etc. (Ref. 1, 2.)

In this case, the driver (a 300 mW. 2N706) supplied 100 mW. to drive the final to 500 mW. Although that is only 7 db. of final gain, the high drive was necessary because of emitter-circuit degeneration; the latter is desirable (up to a point), because it increases linearity of the final, particularly for modulation.

An unbypassed resistor in the emitter is, however, undesirable if it increases emitter circuit inductance (Ref. 5), or requires too much r.f. drive, or reduces power output excessively.

THE VIRTUES OF NEUTRALISATION!

Of special interest in this "QST" circuit is a very important point I have been stressing in correspondence with an author who has sent us a nice transistorised transmitter circuit. WA7FJC says: "Note neutralisation in the final stage. This may not be necessary to prevent oscillation, but it is important in securing good modulation characteristics. Just because an amplifier **does** not oscillate when not **neutralised does** not mean that feedback **does not exist**, but rather that **there is not enough to** cause the stage **to take off. In reality** it may be close **to the edge. The feedback in such an amplifier is not a constant. It varies over the modulation cycle, and its effect on the stage gain varies, so the r.f. output is not a linear function of the modulator output . . . Neutralisation is done by slowly in-**

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creasing the capacitance (of the neutralising condenser) while watching the current meter. At some point there will be a sudden increase in current. Quickly back off the capacitor until the current drops down. Set it (the neutralising condenser) so that you can turn the tuning capacitor . . . about 30° farther toward maximum setting than where the output peaks, before the current jumps up. This is only an approximate setting, but it will keep the amplifier stable, and provide excellent modulation characteristics."

The author also admits an often overlooked fact, that neutralisation of transistor power amplifiers can never be complete, though he overlooks the fact that unilateralisation† can improve it. The actual reason for the trouble is the varicap-effect of the collector-base junction; this is well discussed in Ref. 7. The result is that neutralisation, particularly of a power amplifier, can only be a compromise at best.

What WA7FJC contributes, is to point out that compromise is worth making —a fact generally denied in the fancy technical literature—because of the exaggeration of that varicap effect during modulation voltage peaks. Neutralisation has another unexpected advantage: the detuning of the final on modulation peaks (Ref. 7) is largely avoided and correct tuning of the final is greatly simplified. The same tuning is valid with or without modulation! Very interesting.

Other conditions and prerequisites for good modulation are discussed in Refs. 3 and 4, and likely to appear further there if time permits. I might mention that WA7FJC, like a lot of other good people, modulates his drivers from a tap on the modulation transformer, but this is not necessary, and adds only to modulation transformer problems; see Ref. 4.

I wonder how these brave blokes in America can assault the airwaves with microwatt a.m. signals in competition with the forest of single sideband splatters?

HIDDEN INSTABILITIES

The point made by WA7FJC concerning hidden instabilities is very important. If your power (or other) amplifier does not oscillate when you turn it on, it may still be potentially unstable. If you obtain oscillation, say when the collector voltage is raised above a certain level, or when base bias is reduced, you need not feel pleased if the instability disappears when you reduce the collector voltage or increase the bias. This is a point transistors share with valves, and as I have often maintained, a good knowledge of valve amplifier behaviour is invaluable for understanding much transistor performance.

THE EFFECT OF BASE BIAS

In many transmitters, base reverse bias or bypassed emitter bias is used to drive the stage further into Class C (see Refs. 1, 2, 6), in an effort to obtain higher efficiency and better stability. The higher efficiency can indeed be obtained, but only under certain rigorous conditions, as discussed in those References. But it is quite undesirable to increase base bias merely to keep a stage from oscillating!

Consider the case with valves. In order to ascertain the tendency towards parasitics in an r.f. power amplifier, a searching method is to reduce the class C bias until the valve draws current up to anode dissipation, without any r.f. drive. If instabilities or parasitics are present which were absent with heavier bias, it shows that there is a fault which must be corrected. Because, when the amplifier is biased normally in class C, and when it is driven to the normal pulsed anode current condition, it is **no longer cut off**, and obviously the instability can occur just as it did when the bias was reduced artificially. This results in apparently unexplainable instability, or broadness of signal, or modulation nonlinearity, or excessive harmonic output, etc.—all maddeningly obscure symptoms, obscure because they appear to be hidden when you look for them.

Exactly the same thing happens with transistors, and it matters not at all that the bias-polarity and I_C/I_B characteristics of a transistor differ somewhat from those of a valve. The main problem with transistors is to match them properly, at input and at output, as I shall discuss further in due course.

Once the instabilities have been chased by applying diverse cures (Ref. 7), you can bias the stage or increase the voltage as you please—consistent with limitations of breakdown voltages. If your power amplifier is stable only when you detune it, or only when you self-bias it (e.g. by a base-leak), chase out that instability, don't tolerate it!

THE USES OF HIGH POWER TRANSISTORISED TRANSMITTERS?

In the December 1968 issue of "73 Magazine" is one of many articles on high (for transistors) power transmitters. It is a good example of a point which can well be made about these beasts. That transmitter puts out 30 watts, using the T.I. equivalent of the SE3030, but is high power r.f. in transistors practical? (See Ref. 5.) Can the considerable problems of matching low impedances be overcome satisfactorily? There is an appalling amount of transistor circuitry which simply translates valve configuration into common-emitter transistor design, with scant regard for the one really big difference between them: the transistor is a power-operated device, rather than voltage, and impedances are low. The higher the power, the lower the impedances. This poses the problem of how to get the power in and out efficiently (c.f. Ref. 12).

Certainly some kind of signal can be produced by circuitry treating transistors as small valves, but what kind of practice is that? Consider the output tank of the abovementioned 30w. amplifier. For a Q of 12 (Ref. 5), 1 amp. line current would produce a circulating tank current of 12 amps. in his (essentially) parallel resonant circuit. Obviously he's not attaining a Q of 12 in his little "miniductor" in π-configuration, nor are any of you who use nice miniature output tanks to go with those nice miniature r.f. power transistors.

In addition, modern design calls for loading of even modestly high power collectors by L or T networks, not pi, to obtain adequate coupling with sufficient harmonic rejection. This subject has been covered well in the R.C.A. "Silicon Power Circuits Manual", "Amateur Radio Techniques" (R.S.G.B.), and in much periodical literature here and abroad.

VALVES ARE NICER

Furthermore, that 30w. transmitter takes 4 watts of drive, and the collector efficiency is only 50%. If it were modulated, the driver would also need to be modulated as usual, and output transient voltage problems could be encountered. Any attempt to increase collector efficiency would increase risk of collector or base voltage breakdown. And so forth. A valve at that power is simpler to adjust, easier to drive, easier to power, more efficient, and gives far fewer troubles and harmonics. Good low power (e.g. < 50w.) bottles are plentiful and cheap; over 50w., Eimac has some glorious ones. This is progress?

This fact has been recognised by numerous "hybrid" designs which have appeared in the literature, the most recent being "The 2 Metre Transistor Transmitter Plus One," by R. W. McDonald, "73," Jan. 1969, p. 28. It uses transistors to drive a 6146, explicitly neutralised. It also uses a nice f.m. system with phase modulation in early stages to give 5 kc. deviation at 144 Mc.

In the case of the "6 Metre Exciter," by K. W. Robbins ("73," Sept. 1968, p. 52) only one watt is obtained from a 6CL6 driven by transistors, but this is with a modest anode voltage of 150v.‡ It runs an oscillator at 45 Mc. and uses a 5-6 Mc. FET v.f.o. in a very stable heterodyne arrangement, giving stable mixed output at 50+ Mc.

One intriguing hybrid system was "Five Transistors—Two Tubes—35W.," by J. A. Meissner, "QST," April 1962, p. 16, in which an ordinary transmitter (2E30 → 2E24) is modulated by a transistorised anode modulator, but the d.c. power for the final is obtained by audio rectified from the modulator! This allows:

(1) Mobile operation with low average power consumption;
(2) Always 100% modulation for any level of modulation;
(3) Reduced construction cost, and with the many—
(4) Advantages of a valve in the final p.a.;
(5) It overcomes the traditional objection to valves in mobile: the power converter;
(6) But because of the low duty cycle, the final valve may be run at an appreciably higher input power without damage. You can't do that with transistors, because they don't have a reserve of current carriers. (Ref. 4, 14.)

With modern design, the driver could be transistorised, and no h.t.

† Resistance in series with the neutralising condenser to cancel out negative resistance feedback. See also Ref. 2.

‡ But NEVER run h.t. directly from the mains. No matter what you see in the American magazines, this is a sure invitation to catastrophe.

supply would be required at all! I must build one of these with 3A5s one day.

And that is the reason why you see hybrid circuits from time to time in the literature (e.g. Ref. 8).

WHY THIS ARTICLE?

If you have been brave enough to get this far, you may be wondering about this strange article which comments favourably or acridly on other articles. In this increasingly complicated world there is an excess of information being accumulated, and not enough sense made of it. What is the use of a mountain of technical magazines every month if they merely inundate you with an indigestible array of facts? How many of those circuits are you going to build? How many are you going to remember?

There is a need for articles which correlate it all, bring together main points, and leave the details to the bookshelf. One reason for the deserved popularity of G3VA's monthly "Technical Topics" in "Radio Communication" is the fact that he does just this; it is probably the most significant feature in the whole of the Amateur periodical literature. But there cannot be too much of this kind of correlating, and my present effort has been of that kind, extracting points important for design and discussing them in the light of practical requirements. I invite you to contribute to this effort, too, with suitable articles in "A.R." and to help make more sense out of the Information Explosion.

ERROR

Please note that in the Jan. 1969 "QST" transceiver article by WA7FJC there is a serious error. He has a 4700 ohm unbypassed resistor in the emitter of the r.f. power amplifier. Since its average collector current is about 70 mA., this is obviously an absurd value. The resistance is possibly 470 ohms, or more likely 47 ohms. The unbypassed resistor increases linearity, but if it is too large it reduces collector voltage too much, and it also increases opportunity for emitter-circuit inductance, which is bad (Ref. 5).

REFERENCES

If the Australian "E.E.B." appears here below more frequently than might appear justified by its modest activity, it is only a method to save space. Those references contain a wealth of other references to a wide variety of articles from the literature, many of which are summarised, with comments. A number of other references is listed explicitly in the body of the present article, in text.

(1) "E.E.B.," Aug. 1967, esp. p. 104.
(2) "E.E.B.," Sept. 1967, esp. p. 115, 119.
(3) "E.E.B.," Nov. 1967.
(4) "E.E.B.," Dec. 1967, esp. p. 169.
(5) "E.E.B.," May 1968, p. 46, 49.
(6) "E.E.B.," Sept. 1968.
(7) "E.E.B.," Jan. 1969, p. 3-4.
(8) "E.E.B.," Feb. 1969, p. 21.
(9) "E.E.B.," April 1969, also likely June.
(10) "Amateur Radio," Aug. 1969, p. 11, "Transistors on Computer Boards," by VK-7ZRO and VK7RG.
(11) "Amateur Radio," Dec. 1969, p. 21, "Transistors on Computer Boards—Some Further Thoughts," by VK7RG.
(12) "Amateur Radio," Jan. 1970, p.11, "Commonsense Transistor Parameters," by VK-7RG.
(13) "Coryra,"§ Feb. 1969, p. 4, "The Versatile AY1101," by VK1RD.
(14) "Break-In," Oct. 1966, "The Behaviour of Transistors in Class C Amplitude Modulated Service," by ZL3RH.

§ "Coryra" Publications, P.O. Box 649, Canberra, A.C.T. 2601.

ELEC. CURRENT & OHMS LAW

(Continued from Page 10)

Now total series R = 6 ohms + 4 ohms = 10 ohms.

Then the current in the circuit, from Ohms Law, C = E ÷ R, = 100 ÷ 10. Therefore **total current** = 10 amperes.

Next it is necessary to find the voltage drop across R1 (6 ohms) and the three resistors, R2, R3 and R4 in parallel (4 ohms).

To do this we transpose Ohms Law so that E = C × R. Therefore the voltage drop across R1, 6 ohms = 10 × 6 = 60 volts. Also the voltage drop across R2, R3, R4 (4 ohms) = 10 × 4 = 40 volts. Proof, 60 volts + 40 volts = 100 volts, which is the voltage of the battery.

Thus it will be seen that the voltage across each of the three paralleled resistances is 40 volts, but as each is different in resistive value, it will have a different current flowing in it.

Again we use Ohms Law, C = E ÷ R. Therefore

C through R2 = 40 ÷ 5 = 8 amps.

C through R3 = 40 ÷ 25 = 1.6 amps.

C through R4 = 40 ÷ 100 = 0.4 amp.

Proof: We know that the total current in the circuit is 10 amperes, therefore the total current through the parallel combination of R2, R3, R4 must be 10 amperes.

Then 8 + 1.6 + 0.4 = 10 amperes.

Then answers to the questions are:

(1) Voltage drop across
R1 = 60 volts
R2 = 40 volts
R3 = 40 volts
R4 = 40 volts.

(2) Current in each resistance:
R1 = 10 amperes
R2 = 8 amperes
R3 = 1.6 amperes
R4 = 0.4 ampere.

(3) Total current in circuit: = 10 amperes.

Note that the questions were phrased in such a manner that the logical method of working them out required a different sequence. This is often done in examination papers. Also note that current has been expressed throughout in amperes, voltages in volts and resistance in ohms.

This is because Ohms Law states that:

The current in amperes = E.M.F. in volts ÷ resistance in ohms.

—·—

APOLLO MANNED FLIGHT ROOM AT TIDBINBELLA, A.C.T.

If you occasionally regret the lack of a beam to maintain communications, be grateful you are not forced to the lengths which the space programme demands. Above Leon, a harmonic of VK3TX, is contemplating part of the equipment in the Apollo manned flight room at Tidbinbella, A.C.T. We regret the photograph does not show the UNIVAC computer also, but the photographer had to use something on which to rest his camera!

A Graphical Method for Locating Interfering Beat and Harmonic Frequencies

A. B. HOLLEBON, VK6EQ*

In the design of any equipment which generates its required frequencies by the heterodyne method it is always necessary to guard against the production of unwanted frequencies by the mixing of harmonics of the original input frequencies. Even if the original input frequencies are themselves free from harmonics, the mixing process will generate them and the output signal will contain a surprisingly large number of unwanted frequencies. For example if two signals are mixed and account is taken of all harmonics up to the tenth order, the output will contain a total of 220 frequencies made up of the two original frequencies and their harmonics, plus 100 sum and 100 difference frequencies.

The simple graphical method described below allows all possible beat frequencies and harmonics up to any desired order to be read off directly. For convenience, the following notation is used:

(a) The input frequencies are denoted by X and Y. (If one of the input frequencies is produced by a v.f.o., it should be denoted by Y.)

(b) Harmonics of the input frequencies are denoted by X1, X2, X3, etc., and Y1, Y2, Y3, etc.

(c) The beat frequency produced by the addition of the second harmonic of X and the fifth harmonic of Y is denoted by X2Y5+, while the difference frequency between the same harmonics is denoted by X2Y5—.

AN EXAMPLE

In order to illustrate the method, the following problem will be used as an example. Frequencies of 9.0 MHz. (X) and 5.2 MHz. (Y) are to be mixed to produce a beat frequency of 14.2 MHz. What beat and harmonic frequencies will fall below 20 MHz. if harmonics up to fifth order are considered?

The sequence of operation is as follows:

1. Using a fairly large sheet of ordinary squared graph paper, mark out a scale of frequency on the right hand edge of the paper extending up to at least five times frequency Y. Mark out the **same scale** along the lower edge of the paper extending out to at least five times frequency X. See Fig. 1.

2. Mark a series of points on the left hand edge of the paper to indicate the harmonics of frequency Y. In this particular case, these points would fall at 5.2, 10.4, 15.6, 20.8 and 26.0 MHz. Number these points as shown to identify the harmonics.

3. Mark a similar series of points along the upper edge of the paper to identify the harmonics of frequency X. In this case these points will fall at 9.0, 18.0, 27.0, 36.0, and 45.0 MHz. Draw a vertical line through each of the X harmonic points.

4. From each Y harmonic point draw a line sloping upwards to the right at 45°. These lines are known as sum lines.

5. Draw a second series of 45° lines through each of the Y harmonic points. These lines slope downwards to the right and are known as difference lines.

6. At any point where a difference line meets the X axis a reversed difference line is drawn which slopes upwards to the right at 45°. Sum lines and reversed difference lines are therefore parallel and equally spaced. (The use of reversed difference lines may be avoided if desired by extending the difference lines below the X axis in their original direction and using a double size page of paper.)

All possible beat frequencies produced by harmonics of the input frequencies are now indicated on the graph wherever a vertical X harmonic line intersects a sum line, a difference line or a reversed difference line. The frequency of any particular beat may be read off from the right hand scale. The combnation of frequencies producing that beat may be determined by

(Continued on Page 15)

X0		X1		X2		X3		X4		X5	
Y3	15.6	X1Y2+	19.4	X2Y0	18.0	X3Y2—	16.6	X4Y4—	15.2	X5Y5—	19.0
Y2	10.4	X1Y5—	17.0	X2Y1—	12.8	X3Y3—	11.4	X4Y5—	10.0		
Y1	5.2	X1Y1+	14.2	X2Y5—	8.0	X3Y4—	6.2				
		X1Y4—	11.8	X2Y2—	7.4	X3Y5—	1.0				
		X1Y0	9.0	X2Y4—	2.8						
		X1Y3—	6.6	X2Y3—	2.4						
		X1Y1—	3.8								
		X1Y2—	1.4								

Table 1.

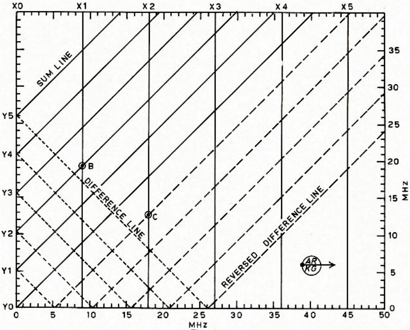


Fig. 1.

* 76A Fifth Ave., Shoalwater Bay, W.A., 6169.

SIMPLE "NO HOLES" MOBILE MOUNT

Some time ago, when I had a tow-bar on my car, I made up some mobile antenna bases using a pipe cap into which was cast an epoxy resin. By using a muffler clamp and a piece of flat steel about 12" x 2" x ¼" the base was mounted well clear of the body-work of the car; it could also be easily adjusted for rake.

As the tow-bar had never been used for its designed purpose of towing a trailer I decided when I bought my present HK Holden that the bar was an unnecessarily expensive luxury and sought another method of mounting the antenna base. It appeared that a bracket made from 0.064" (16 s.w.g.) half hard aluminium would be strong enough and so this was tried out. On my second try, I hit upon a design which is simple to make, unobtrusive, and strong enough to stand upon. It can be made to fit any bumper, regardless of contour.

I will describe my mount, which is designed for a HK Holden, but, which should fit some other models with little or no modification. Dimensions can be adjusted to suit the particular type of bumper bar used on your car.

Materials required are: a piece of half hard aluminium 12" x 4" x 0.064" and two "Jubilee" hose clamps of a size large enough to go around the girth of the bumper for Holdens. They need to be about 13" long and I have used No. 5's.

The aluminium is cut and folded so that four lugs 1½" wide protrude on either side of the body of the mount and the clamps hold the unit firmly in place against the bumper. I found that it was a good idea to form a small hook on the top piece but found that such a hook was a disadvantage on the bottom.

Having marked out your piece of metal and cut the notches in to the drilled holes, it is a simple matter to fold the flaps inwards in a vyce by using a couple of short lengths of angle iron or hardwood of appropriate size. This will permit you to fold only to a right angle. At this point, if you feel that you would like a stronger mount, another strip two inches wide and about nine inches long is placed inside the channel and the flaps closed over it. My mount appears to be strong enough without the additional piece.

The 2" piece across one end then has a 90° bend put in it and with a piece of ⅛" thick material inside the bend, a hook is formed.

Now mark the position of the hole for your antenna base and after cutting the hole, the mount can be fitted to the car using the jubilee clips.

Please note that the rear bumper of HK Holdens have a protruding lug under the bumper in the most appropriate mounting place and if the mount is made wider than 2" it will not fit. You can, of course, make it wider and fit it nearer to the number plate cut-out if you wish.

Those who have different types of car may find the following hints helpful.

Measure the girth of the bumper, add about one inch and use this dimension to purchase the Jubilee clamps. If you cannot get one to go right around the bumper, they may be opened up and joined end to end.

An easy way to establish the sizes of the top and bottom sides of the angle is to loop a tape measure around the bumper bar and with a pencil or large nail work on the extended loop to establish the dimensions X and Y which are, of course, 5¼" and 6" in the case of HK Holdens.

I found it convenient to drill ⅛" diameter holes at the ends of the pieces to be notched out and then cut the notches with tinman's shears.

Those contemplating mobile operation for the first time may wonder how they can get the co-ax from the trans-ceiver to the mount without disfiguring the car. This is easy as the door sills are removable and so the co-ax can be run under them along one side, up under the back seat and down into the spare wheel well. In the bottom of this well can be drilled a hole which you will later fill with a grommet before disposing of the car or you can use the drain hole provided.

Happy Mobiling, Syd VK3ASC.

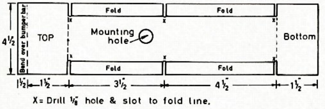
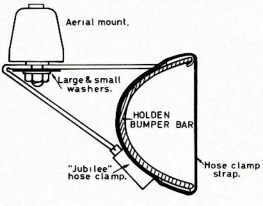


FIG. 1. NO HOLES - AERIAL MOUNT.



A GRAPHICAL METHOD FOR LOCATING INTERFERING BEAT AND HARMONIC FREQUENCIES

(Continued from Page 14)

following the sum or difference lines back to the Y axis, and by following the vertical lines down to the X axis to locate the harmonic concerned. In the case of a beat which occurs on a reversed difference line, it is necessary to follow this line down to the X axis and then follow the corresponding difference line up to the Y axis.

For example, point B represents the beat frequency X1Y2+ (19.4 MHz.), while point C represents X2Y1— (12.8 MHz.).

Table 1 shows all harmonic and beat frequencies below 20 MHz. as read from Fig. 1. The values in each column are those obtained by reading down each X harmonic line in turn.

This method of predicting beat frequencies may be extended to cover the case where one of the input frequencies is variable. This situation arises when a v.f.o. is used in a transmitter which then heterodynes the signal to the final output frequency.

The graph is drawn up in the usual way using the lowest available v.f.o. frequency and plotting its harmonics on the Y axis. Each of the predicted beat frequencies is then transformed from a sum line or a difference line and downwards from a reversed difference line. The length of the vertical line drawn from any intersection point is equal to the v.f.o. tuning range multiplied by the order of the sum, difference or reversed difference line on which it is based.

If for example the 5.2 MHz. signal in the above system was derived from a v.f.o. with a range of 5.2-5.5 MHz., then point B (19.4 MHz.) would be transformed into the range 19.4-20.0 MHz. since B lies on a second order sum line. In a similar manner point C (12.8 MHz.) would be transformed into the range 12.5-12.8 MHz. since C lies on a first order reversed difference line.

Overseas Magazine Review

Compiled by Syd Clark, VK3ASC

"HAM RADIO"

July 1969—

Log Periodic Yagi Beam Antenna, W6SAI. As its name implies, this antenna is a combination of the L.P. and the Yagi. The L.P. antenna is a very useful device when it is desired to operate over a wide band of frequencies, i.e. 3-30 MHz. It is not so useful when narrow, harmonically related bands are used. Bill Orr suggests this as one answer to the problem.

C.W. Transceiver for 40 and 80 Metres, by K3OIO. FET front-end, followed by a mixture of bipolar transistors and FETs until a 12AU6 driver is used to drive a 1625 final. Some would say why a 1625? He had it on hand.

Direct Methods of Measuring Antenna Gain, K6JYO. Describes how to obtain meaningful data using simple equipment. VK3ATN rates a mention.

The Crystal Oscillator, W6GXN. A complete summary of solid state devices as crystal oscillators to enhance your technical reference file.

Complete Transverter for Six Metres, by WA9IGU. Showing how you can get on 6 mx s.s.b. using one of these and a 40 mx transceiver.

Stub Bandswitched Antennas, W2EEY. Describing two multiband verticals, a fixed station antenna and a twin lead portable—no loading coils or traps.

Glass Semiconductors, W1EZT. Who said glass is an insulator? It seems some of it is semiconductoring.

A 40 Metre Bobtail Curtain Array, VE1TG. A modified three element broadside antenna that will more than double your radiated power.

August 1969—

A Large Homebrew Parabolic Reflector, by WB6IOM. Complete details for a sixteen foot parabolic reflector using honeycomb sandwich construction. Honeycomb foil and epoxy as a filler is becoming popular in many places. This will probably interest the Moonbouncers.

Solid State Q5'er, W5TKP. Replacing hot tubes with cool transistors makes this 21-year-old veteran better than ever. Two versions are described by W5TKP, "the Q5'er reviver."

Distortion in F.M. Systems, W5JJ. Adjustment of receiver and transmitter for optimum performance in the f.m. mode.

Simple Frequency-Divider Calibrator using MOS ICs, W6GXN. MOSFETs have been used in many Amateur r.f. amplifier designs. Here is a different application.

Putting Together a Mobile Installation, by W0FCH. A recipe for summer fun. Using a Galaxy, too, ah what Bles, sri bliss.

A New Multiband Quad Antenna, DJ4VM. This driven array features several improvements over conventional quads for three-band operation.

A New C.W. Monitor, W2EEY. The versatile IC appears again—this time in an r.f. actuated keying monitor featuring the low cost uL914.

A Combined Digital and Burst Encoder, by K8AUH. Selective call and tone burst signalling provide enhanced f.m. operation.

September 1969—

F.M. Techniques and Practices for V.H.F. Amateurs, W6SAI. History and information on the advantages and disadvantages of f.m. Practical circuits are discussed and some commercial equipment is described.

Using Integrated Circuits with Single Polarity Power Supplies, W2EEY. This clears up the question of power-supply connections to linear ICs and preesnts some hints on lead dress and bypassing.

A Frequency Tripler for 1296 Mc, W4API. Introducing the varactor as an efficient microwave harmonic generator for transmitting use.

Tunable Band Pass Filters for 25 to 2500 MHz. K6RIL. Here are some useful additions to your v.h.f. and u.h.f. test equipment.

Single-Pole Band Pass Filters, W6HPH. Filters for operation on 21, 28, 50 and 432 MHz. are described.

Standards for Amateur Microwave Communications, K6HIJ. This standard microwave system offers a practical means for Amateur work above 1 GHz.

Solid State Modification of a Mobile Converter, John R. Schuler. An easy way to modernise a Gonset tube converter for mobile use.

Affect of Mismatched Transmitter Loads, by W5JJ. Does the character of the load affect power amplifier efficiency?

This completes the run-through of nine issues of "Ham Radio" which have arrived to date. My summing up of the journal is that it presents items of interest to all Amateurs in a very complete manner. Text is comprehensive without being unnecessarily wordy. Production is clear and precise and any comments which are made are done in a dignified manner. I have no hesitation in recommending this journal to my fellow Amateurs.

"QST"

November, 1969—

The Collinear Yagi Quartet, W6KPC. It has often been said that an outstanding aerial will get better results than high power. This design, which consists of four six element yagis, the upper pair 103 feet above ground, has a gain of about 15 db. on 10 metres.

Let's Talk Transistors, by Robert E. Stoffels. Reprinted from Telephone Engineer and Management. Part One covers the structure of matter and its application to transistors. This is the first of a nine-part theoretical series; written especially for persons with a limited technical background.

A Solid State Speech Processor, WB2EYZ. A controlled amount of clipping added to compression gives a better overall result, in speech processing than does either alone.

A Code Practice Oscillator and C.W. Monitor, WB6TUM. A simple gadget for the beginner in Amateur Radio or solid state technique.

A 21/28 MHz. Transverter for 3.5 MHz. Transceivers. If you are stuck with a monoband transceiver for the 80 metre band, this article shows how you can get onto ten and fifteen with relatively little trouble and expense.

Atmospheric Noise and Receiver Sensitivity, W7IV. The statement is often made that receiver noise figure tends to unimportance as the frequency of transmission falls. Here are the figures to demonstrate the point.

A Co-ax Fed Trap Dipole for 80 to 10 Mx, W1ICP. Here is a multiband aerial which is easy to make and adjust. It can be used with one or two poles for support.

Perfect Morse Code from Teletype Tape Inexpensively, K1PLP. A minor plug-in modification to a transmitter-distributor and you can use a teletype machine to send Morse at about quarter of teletype speed.

Recent Equipment. "QST" reviews the Inoue FDFM-2. A small 2 metre transceiver running about one watt output from dry batteries and two watts from an accumulator. Sells in the U.S.A. for about 250 dollars. It has a larger brother which gives at least five watts output and sells for about 300 dollars. W1HDQ seemed to like the rig which he suggested as being good value for money. They have not yet been seen in Australia.

Transmission Line Sections for R.F. Chokes and By-passing, W6AXT. At v.h.f. or u.h.f. line sections perform better and are practical substitutes for the usual types of r.f. chokes and by-pass capacitors.

AWARDS FOR TECHNICAL ARTICLES

With the change in the closing of our financial year to the end of December, it was necessary for the Publications Committee to consider the awards for articles published during the year a little earlier than usual. This matter was considered at the December meeting and it was unanimous that the series on the Solid State Transceiver by Harold Hepburn, VK3AFQ, and Ken Nisbet, VK3AKK, was a clear-cut winner, and the top award has been shared by these gentlemen. Awards have also been made to Col. Harvey, VK1AU, and Wal. Salmon, VK2SA.

Our congratulations to all these Amateurs, and we trust we will have the pleasure of receiving further material from them all.

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HIGGINBOTHAM AWARD

Some sort of record has been established this year as for the second year in succession, the Higginbotham Award has gone to Rodney Champness, VK-3UG, in recognition of his consistent work for and submissions to "A.R." Congratulations Rodney.

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CURRENTLY RADIATING SATELLITES

The following are satellites currently radiating and observation of which is reckoned to be of scientific value. The list does not therefore include all satellites radiating. These data have been taken from COSPAR Information Bulletin for October 1969 by VK3TX.

The Designation is followed by the Name and Frequency MHz. (Power).

CONTINUOUS BEACONS

1964-6A—Explorer 22—20, 40, 41 (250 mW.); 360 (100 mW.); 162, 324.

1966-110A—ATS-1—136, 47, 137.35 (2 watts).

1968-02A—Explorer 36—162 (300 mW).; 324 (400 mW.); 972 (500 mW.).

1968-69A—ESSA-7—136.77 (250 mW.).

1968-84A—Aurora—136.170 (200 mW.).

1968-100B—TTS-2—136.86 (100 mW.).

1968-110A—OAO-2—136.441 (160 mW.)

1968-114A—ESSA-8—136.770 (250 mW.)

CONTINUOUS TELEMETRY

1966-16A—ESSA-2—137.550.

1967-114A—ESSA-6—137.500.

1968-17A—Explorer 37—136.521, 137.590 (150 mW.).

1968-114A—ESSA-8—137.620 (5w.).

1969-37A—Nimbus 3—136.950 (5w.); 136.50.

Correspondence

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

MORE ON THE USE OF C.W.

Editor "A.R.," Dear Sir,

The letter from VK3ZJC published in December issue indicates a lack of appreciation, which is quite common in correspondence on this subject, of international regulations to which Australia subscribes as a member of the International Telecom. Union.

It is by international agreement that a demonstration of proficiency in c.w. must be demonstrated by a candidate for a licence granting operation on DX bands.

Personally, I can assure the writer that I am not a "brass pounder", my interest lies in QSP SSB DX, but I did not expect a change in international requirements to suit my interests.

As for stratifying Amateurs, is this not common to all fields of endeavour; greater reward requires greater exertion. The latest trends overseas, especially in U.S.A. which country has the world's largest Amateur population, has been to extend the scope of incentive licensing; power, frequencies, etc., being dependant upon the level of examination passed.

In many countries, including U.S.S.R., which has the second largest Amateur population, quite severe restrictions are placed on new licensees until they have proved their c.w. proficiency in actual operation under supervision.

Personally, I feel that "Limited" licensees have a "good go" in this country compared to most other countries which "tolerate" Amateur Radio. Let us not forget that the demands on "our" frequencies by other Services are such that we should all look to the definition of Amateur Radio as a Service of **self training.**

—Bert Foster, VK5EW.

Editor "A.R.," Dear Sir,

Mr. Martin, VK3ZJC, hopes that his comments regarding c.w.—or the deletion of it—will provoke "discussion" which would be the understatement of the year as this could be spread throughout the pages of this journal but to take the load off the Editor, let's summarise it by saying, Mr. Martin you like phone or more precisely, you dislike c.w. partly because—

(a) You consider is archaic;
(b) It takes up room that could be used by phone stations;
(c) You find the code difficult to master, and
(d) It prevents you using some Amateur bands.

In relation to (a), your view that c.w. is old hat would be hotly contended by thousands of Amateurs throughout the world who enjoy it as THE mode of operation. They do not decry other modes. This is a free choice hobby in which (to the irony of some) others still prefer a.m., some s.s.b., and some f.m. We like c.w.!

As for (b), the operation of slow scan t.v., r.t.t.y. and facsimile come into the category of c.w. and must therefore be taking up precious space although one does not need to read code to use these transmissions.

In (c) lies an honest statement that you find it hard to master the code. Believe me, OM, everyone finds it hard going at the beginning, and if I sound like Father Time then that's hard luck, but if you stick with it, it will eventually "click". Even the Apollo teams found it a bind, so we are told, but they still had to learn it as a back-up facility. Once you beat it you'll find the c.w. gang just as enthusiastic, dedicated and proficient as any other segment of Amateurs.

Finally, relating to (d), you say that you are prevented from using six Amateur bands because of the retention of the c.w. requirements. The Amateur Service is tolerated partly because it constitutes a force of trained operators and technicians capable of supplying emergency communications and the most reliable mode is c.w.—it is as simple as that. As members of that Service let's stop quibbling about idiotic trivials and concentrate on decent transmissions. We may retain our bands in that way.

—B. S. Clarke, VK5BS.

Editor "A.R.," Dear Sir,

I would like to comment on the letter of John Martin, VK3ZJC, concerning Morse and Novice licences.

When, as VK3ZOM, I got some QSL cards, I added the letters F.M.S.T. after my name. I had earned the title. In small letters at the bottom of the card it explained that the letters stood for "failed morse seven times".

I tried first in 1950 and practised with a friend. After some months we sat. He passed and I failed. I did the same thing with another person who was learning. After having failed five times and seen two people who started from scratch with me both pass, I gave it away. There was no Limited licence in those days.

About twelve years later—having lost all the credits for the theory and regus., I did the whole show again, with the same result, but this time I got a Limited licence. I had another go later at the Morse, now 14 w.p.m. and missed again.

A friend, who had taught Morse, tried an interesting test. He read out, **in English**, a series of letters and timed the speed at which I could take them down. He found my reaction time, etc., was such that I broke down at 15 w.p.m. Under these conditions I had no hope of taking Morse at 14 w.p.m. I gave it away.

When the 10 w.p.m. test came in, however, I decided that I had enough margin and what had been a physical impossibility was now merely a matter of work and practice. With the aid of a tape recorder and an ear plug (in trains and trams and lunch hours), I eventually made it. Having done things the hard way I have come to the following conclusions.

First of all find out if you have a real chance by getting someone to time your ability to write down letters one at a time when they are dictated in English. If you have 50 per cent. or more margin over the code speed, you can do it. Then when you learn the code do all your practice in code groups of mixed figures and letters. **Never take any plain language.**

I came out of the exam—the one I passed—without the slightest idea of what I had been writing. Not many people realise that—

t h e r e i s n o n e e d w h a t e v e r t o s p a c e t h e w o r d s a s l o n g a s o n e g e t s t h e 1 5 0 l e t t e r s c o r r e c t a n d t h i s i s e x a c t l y w h a t i d i d.

I may be biased but I still feel annoyed about the idiocy which insisted on 12 and later 14 w.p.m. for Amateurs when **commercial** operators could get a licence at 10 w.p.m., but that is now old hat. What I think should be done now is to have phone and c.w. bands after the fashion of the U.S.A., with possibly some other additional encouragement to those who wish to learn **and use** c.w. But John Martin is himself rather unfair. Just as some able c.w. operators assume that "anyone can pass the Morse test" he seems to assume that "anyone can pass the theory". I would suggest that at least as many candidates have as much trouble with theory as with Morse, especially now. Even back in 1950 when I first sat for the exam. I had had more experience in radio than most examinees, including some years at radio repair work. But while I could answer questions about superhets in my sleep I found all the questions about transmitters, standing waves, aerials and so on required a lot of work and study. One can at least practice Morse before the exam., but one can't practice transmitting until one has passed!

I most definitely think there should be a simplified theory exam. to encourage Novices and that they should have the option of having the use of the c.w. bands if they also pass a simplified Morse test, say 5 w.p.m. After a year or possibly two, the Novice should be able to pass the full theory exam. and, if he wishes, the 10 w.p.m. Morse and thus acquire a full licence. Meantime, he will be entitled to use the normal bands but with a maximum power of say 10 watts. Essentially the Novice licence would be a means of giving a beginner a chance to learn enough to pass the full test.

—Roy Hartkopf, VK3AOH.

OBITUARY

BRUCE CHAPMAN, VK2BA

Old Timers will be sad to learn of the death on 27th November, 1969, of Bruce Chapman, VK2BA, who passed away in the Royal North Shore Hospital after a long illness.

In the early 30s, Bruce took an active part in Amateur affairs in N.S.W., and was one of the top c.w. operators of that time. For a period before the last war, he was stationed at Tulagi in the Solomon Islands and under the call sign of VR4BA became well known on the air as at that time he provided one of the few Amateur Radio links with that area of the Pacific.

After War Service with the Royal Australian Navy in the Pacific area, he set up again from Sydney as **VK2BA.**

Although not active on the air in recent years, he retained his keen interest in the technical side of Amateur Radio and at the time of his death was accumulating some sophisticated equipment with the intention of making a "comeback" on the air from a property which he had acquired at St. Ives, N.S.W.

Bruce's passing will be a loss to those who knew him and who were his associates both in business and Ham Radio affairs.

ARTHUR GEDDES HENRY, Ex-VK2ZK

Arthur Geddes Henry, who used the call of VK2ZK in the late 1920s, was an excellent Morse operator and won the W. T. Crawford Trophy in that field on at least two occasions.

During the war, and after, he was too busy to continue Amateur activities and he allowed his licence to lapse. At no time however did he lose interest in Amateur work and his passing is a sad loss to us all.

Born in 1907, Arthur was an engineer with the N.S.W. Railways when he enlisted in June 1940. His army number was NX 12466, and he progressed through the ranks to the rank of Major. Arthur served in Signals in the Middle East, covering the campaigns in Greece, Crete and Syria, and later had periods in New Guinea and Morotai.

Arthur was 2 I/C 5 WT in 1 Aust. Corps Sigs. and joined Australian Special Wireless Group as 2 I/C at the Group's inception in May 1942. He finished his service with Central Bureau and left the Army in November 1945.

He was a lovable character and although his parade ground standards rarely reached Duntroon heights, he was always popular and much of the success that the Units achieved can be attributed to his resourcefulness.

He joined the Unit at Seymour, whence he arrived from Sydney, bringing with him all the Ham operators that he could collect —skilled operators, signalmen able to identify operators by their style of sending—indeed manna from heaven in those early days of the war.

Intensive training began, on equipment that was in various miraculous ways obtained for the Unit by Arthur and John Ryan, with a result that it was a well-trained team that went to Greece. The section met with instant success and played a valuable part in the retreat in Greece. Then followed the grim days of Crete when again the section fulfilled a vital role.

Arthur's strength of character showed up when the order to head for the ports and abandon the island was given. His concern was the transport and he and a few drivers were a week later than the main body in getting off, because he determinedly got his trucks through to the embarkation point only then to have to destroy them.

His technical knowledge and experience proved a great asset when the section was expanded into the group.

Always a keen photographer, on a recent trip to the M.E. he took photographs from the same places as 26 years previously, and compared the views.

Williams Fitzmaurice Hill ably says for us all: "Arthur was a wonderful comrade, a man to be respected, with a vast store of technical knowledge. He would not wish to be mourned. We who are left, can look into the West and remember."

Vale, Arthur!

CYRIL BAKER, VK6ZBG

It is with deep regret that we report the passing of another of our Amateur fraternity in VK6, in the person of Cyril Baker, VK6ZBG. Cyril passed away on 22nd November, 1969.

Since receiving his licence in February 1965 he was often heard on six metres using both f.m. and a.m. and also on two metres a.m. Although Cyril had not enjoyed the best of health during the last twelve months, he was still mobileering right up to the time of his passing.

The VK6 Division extends their deepest sympathy to his family in their bereavement.

VHF

Sub-Editor: ERIC JAMIESON, VK5LP
Forreston, South Australia, 5233.

1970 is with us now and what a start it got in VK5. Gales and heavy rain lashing the State, near freezing temperatures, none of which were very conducive towards spending time in shacks looking for the DX which only turned up in the form of brief openings to VK4 and VK6. Quite a bad start for the enthusiasm shown in VK2 for any hope of Interstate contacts on a large scale for the launching of their introduction to the AX prefix with a 24-hour contest for v.h.f. operators. But maybe conditions were better in the east, in the absence of reports to the contrary we will hope so.

Six metre DX has been spasmodic as predicted. However, the VK4s and VK6s were observed having a "real ball" on Saturday, 27th Dec., when for several hours the two States worked right across Australia. Here in VK5 we could hear both sides of the contacts, and that's about all we could do, too, as neither of the parties concerned wanted to miss those 2,000 mile contacts.

That same day saw probably the greatest activity of the DX season on 2 metres. Early in the morning S9 contacts were available across the border into VK3 Western Zone with our old friends Roy 3AXV, Roy 3AOS, Jim 3AEF, Bob 3ARM, with a newcomer Eric 3ZKN near Hamilton being available. In the S.E. of S.A., Trevor 5ZTN and Col 5CJ held the fort, while John 5QZ portable at a place called Birthday Hill, some 36 miles south of Woomera, had a rather lonely time with the longest distance worked to 5LP on a hill near home. Not content with this sort of activity entirely, Wally 5ZWW proceeded to make tape recordings of VK6VE, the beacon on 144.500 at Albany, audible with long slow QSB from 0645 to 0830 E.S.T., varying from S2 to S5, and again that night from 2030 to midnight to S5. The path is about 1,100 miles and if only you chaps in VK2 and VK4 could realise the "kick" one gets from hearing even beacons on 2 mx over these distances, I am sure you would get on with the job of constructing 2 mx beacons in your States!

The only reports of signals from Japan in the VK5 regions this season was that from Wally 5ZWW who identified JA5DEI at 1815 E.S.T. on 52.010 MHz. on 19th Dec. Maybe we can get a roundup of news from the North for the next issue from Lance 4ZAZ who certainly has his share of contacts with exotic areas.

NEW 576 MHz. RECORD?

As the result of my much advocated portable operation, it seems likely a new distance record has been set for 576 MHz., this time in the vicinity of 200 miles on 28th Dec. The participants were John 5QZ, assisted by Treva 5ZIS, who situated themselves on Hancocks Lookout in Horrocks Pass near Port Augusta, and Graham 5ZJL conveniently placed about 15 miles south of Port Lincoln. John reports signals were extremely strong on 2 mx, even on the whip antenna. On 576, signals both ways were S8/9 with virtually no QSB. The equipment used was stabilised gear at both ends. Both parties used similar receiving equipment consisting of modified 5QZ type 432 MHz. converters for use on 576. The two transmitters were using QQE03/20s with about 5 watts output on a.m. 5ZJL used a 16 element phased array of standard arrangement. 5QZ used a 32 element extended array. Most of the distance consisted of a water path. A claim for the record is to be lodged shortly. I am sure all Amateurs will say well done to these enthusiasts. Next month it is possible a photograph of the specially made car-roof mounted 32 element antenna used by John 5QZ will be available for publication.

On the subject of portable operation and just what can be done, it is pleasing to note Bob 3AOT was going to operate from Mt. Buninyong, near Ballarat, from 3rd to 11th Jan., on the 52, 144, 432 and 1296 MHz. bands! It is hoped something can be passed on to you from this well organised operation, which is perhaps a trial run for the John Moyle National Field Day on 7th and 8th Feb.

Everyone is reminded that this Field Day provides an excellent opportunity for hill top and other portable operation as there are two periods, one for 24 hours, the other for 6 hours. It seems likely there will be quite a bit of activity of this nature in VK3, and probably VK5, which will be well supplemented by the VK2 VHF and TV Group who are combining their VHF/UHF Field Day to coincide with the N.F.D. Providing the weather pattern is suitable with the likely measure of activity already indicated, chances readily exist for some really long distance contacts. If Eddie 1VP is able to get out on Mt. Ginini, near Canberra, during the same period the plans will be complete. Full details of the John Moyle Field Day have already been provided in "A.R.," read them carefully.

Much interest and activity seems to be centred in and around Melbourne on 1296 MHz. at present. According to Peter 3ZYO, there are about eight active stations on the band, and nightly skeds are kept over 50-mile paths. Ron 3AKC and Wilf 7WF are working towards extending the present 136-mile record for the band to 223 miles. At the time of writing, nothing has come through of any success, but when it does I hope to be able to give you all plenty of details. Good luck gents. I wonder how long it will be before Rod 2ZSB (ex 5ZSD, 6ZDS) starts stirring up interest on this band in his area, perhaps to work ZL? v.h.f. and s.s.b.

Listening around the bands and overhearing conversations, one cannot help but feel a controversy is in the making and as far as I can gather centres around those not able to receive s.s.b. signals on v.h.f. as distinct from those who won't work s.s.b. stations, there being quite a number in the first case, and a few in the second. Personally, although I advocate full station facilities wherever possible at any time, and this includes the facility of being able to receive and work s.s.b. stations, however no one has the right to expect all stations whom they might select at random to be adequately prepared to work any mode: there may be perfectly valid reasons for any such inability, lack of finance, ability or skill, not on the air long enough, shortage of time, breakdowns, etc. At the same time one could conceivably expect a station running high power generally to be in a position to receive all modes, but this may still not always be so.

It seems, therefore, that if you operate s.s.b. on v.h.f. and call an a.m. station, you must be prepared to accept the fact that a percentage of such stations will not be equipped to read you, likewise, if the a.m. operator calls a s.s.b. station, he too may not find himself being read either if his signal is not stable, as a good s.s.b. receiver receives the a.m. signal on one sideband only, and if you wobble around much he can't read you either. So, until you have what could be a classic example of an a.m. station calling an s.s.b. station and then telling him he can't read his signals due to no b.f.o., none of you really have a case to argue!

However, to try and spread the versatility of operation as much as possible, it seems desirable for some assistance to be available to get more b.f.o's and product detectors into receivers and with this in mind, I am hoping to arrange for an article on this very subject to appear in "A.R." in the near future. In the meantime, let everyone place this matter in its proper perspective, and think before talking. And all credit to the young chap who recently came to light with a Pye Reporter, tuneable over 6 metres, and with a b.f.o.!!

My predictions last month that the VK6s would not let us down by not having their 2 mx beacon running has already been proved by the note about its reception here in VK5 earlier in this column. The current list of beacons is as follows:—

ZL2	50.750	Wellington t.v. sound.
ZL3	145.000	ZL3VHF.
VK2	51.740	Channel 0, Western N.S.W.
	143.750	Channel 5A, Wollongong.
VK3	51.760	Channel 0, Melbourne.
	144.700	Under construction.
VK4	51.750	Channel 0, Brisbane.
VK5	53.000	VK5VF, Mt. Lofty.
	144.800	VK5VF, Mt. Lofty.
VK6	52.006	VK6VF, Tuart Hill.
	144.500	VK6VE, Mt. Barker (Albany).
	145.000	VK6VF, Tuart Hill.
	435.000	VK6VF (on by arrangement).
VK7	144.900	VK7VF, Devonport.
JA1	51.996	JA1IGY, Japan.

I was very pleased to receive a letter from David VK3QV with some very interesting information from Al. Edwards, KR6TAB following a contact on 28 MHz. on 27th Dec. Al. has been in Okinawa for 10 years and during that time has worked on 52 MHz. to VK4, 6, 8 and 9. Doug VK8KK has mentioned Al. as being worked from the Darwin area. Unfortunately, Al. will be retiring from Federal Service soon and leaves to settle in California in March, and will have the call KH6FJY/W6 pending allocation of a call with the prefix WC6. In U.S.A. he will be confined to 50 MHz. and above as he has a Technicians licence. On Okinawa this is distinguished by the letter T in the call, which also allows him to operate on 28 MHz. there, but not in the States. Channel 0 television from Brisbane had been copied a number of times in Okinawa.

Members of the indigenous population are allocated KR8 calls, and at Oct. 1969 about 110 such calls had been issued. Apparently a couple have shown interest in 6 metres so there may be someone to carry on the good work from there. The native tongue is Japanese, and Al. says their standard of English is not as good as most JA operators, so here may be one stumbling block. So exit to a keen v.h.f. operator in the north; we here in VK will be the worse for the ending of this particular era.

Remember to send in your logs for the Ross Hull Contest, full details in October "A.R." Hope also to hear you portable in the John Moyle Field Day, 7th and 8th Feb. Will close at this point as I want to leave a little more room for some of the very interesting things which can be written about this month's "Met the Other Man". Thought for the month: "A lie may take care of the present, but it has no future."

73, Eric VK5LP. The Voice in the Hills.

MEET THE OTHER MAN

Meet Ron Wilkinson, VK3AKC, ex VK3ZER, who lives at Newtown near Geelong, at an elevation of about 150 feet, right near the water in a DXer's "paradise". First licensed in 1957, Ron now operates on 52, 144, 432 and 1296 MHz. bands. On 52 he runs 18 watts to a QQE03/12 coupled to a 5 element wide spaced yagi, 30 feet high. Receiving is done with a 6AG5 in the front end of the converter. Due to Channel 0, activity is restricted to Sunday mornings or after t.v. closes.

On 144, Ron runs two transmitters, both using QQE06/40s, one on s.s.b. 250 watts p.e.p., the other 60 watts of a.m., with a 16 foot long 10 element wide spaced yagi, 50 feet high, 6CW4 cascode converter.

On 432, another 6/40 is used to give 60 watts to a 52 element (4 yagis) array at 39 feet, with an AFY16 cavity front end in the converter. The tunable i.f. is 9 MHz.

Of comparatively recent times Ron has launched out on 1296 MHz. and made his presence felt. Running 3 watts to a 2C39BA in a radial cavity to a 6 ft. 9 in. dish, he has worked VK3ZKB more than 70 times over a 51-mile non line-of-sight path, with signals S6 to S9 plus. The station modulator used with the a.m. equipment is zero bias 807s, running about 75 watts.

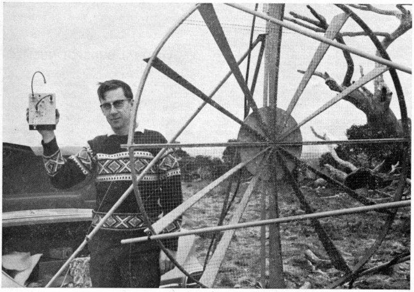
All VK call areas 1 to 9 inclusive plus ZL1 to 4 have been worked by Ron on 6 metres,

plus 120 JA stations. Has also worked K6HGP in Hawaii, following this contact he was called by a W8 but unable to make contact. Has also been heard by VE7AQQ and has a card to prove it! On 144 VK2, 3, 4, 5 and 7 have been worked, the VK6 beacon at Albany has been heard on a number of occasions, and has also worked ZL2 and ZL3. On 432, VK3, 5 and 7 represent his efforts, and is currently attempting to create a record on 1296 MHz. by working VK7WF, a distance of 223 miles. Knowing Ron and his efforts, he will do it! The Ross Hull Memorial Contest Trophy has twice been won by Ron, and on one occasion he came second.

With the return of the requested information Ron sent along some additional notes which set out more clearly some aspects of his v.h.f. operations. On 146 f.m. he regularly works the boys in VK7, both base stations and mobiles, for this he uses a 10 element vertical 40 feet high, running 15 watts f.m. The coaxial cable used on all bands is PT29M which has a loss of 6.33 db. per 100 feet at 1,000 MHz.

On 432 Ron mentions working six north coast VK7s at distances of 223 to 275 miles, two of these consistently throughout the winter months, too. On 1296 MHz. Ron finds the 6 ft. dish works very well, fed with 30 feet of PT29M. This goes into two trough line cavities—one for the diode multiplier on 1152 MHz., which is a 1N82A, the other to a 1N3ER diode mixer. This is fed into the 144 MHz. converter then to the 9 MHz. tunable i.f. in the hotted up AR7. The 1296 transmitter consists of a QQE06/40 on 432 driving a modulated tripler, a 2C39BA in a radial cavity with 3 watts output. Both 432 and 1296 together, are modulated for best results. The radial cavtiy was built by Les VK3ZBJ.

Looking to the future, Ron says he is going all out for this record attempt with VK7WF on 1296, and said the building of the 6 ft. 9 in. dish was a large undertaking. He finds different heights suit some areas, not others. A difference of four feet suits one part of Melbourne, and full height of 40 feet suits another. He concludes 1296 to be a very interesting band and has stirred sufficient interest in VK7 for other stations over there to want to try and cross the water as well. Good luck to all in these experiments with low power.



Bill VK2ZAC at his location, Mt. Ginini, 30 miles south of Canberra, A.C.T., 7/12/69.

Dick VK2BDN at his location, trig point on Mt. Canobolas, 7/12/69.

149 AIR MILES ON 1296 MHz.

After about 12 months of improving gear and finding a suitable path on Sunday, 7th December, 1969, at 0905 hours, Bill VK2ZAC and Dick VK2BDN worked over a distance of 149 miles on 1296 MHz. with signals 5 and 9 both ways; this distance bettered the previously set record by 16 miles (VK4KE/4 and VK4ZJ/4 made contact over a path of 132.6 miles on 2nd February, 1969).

Bill VK2ZAC was located at Mt. Ginini, 30 miles south of Canberra, A.C.T., while Dick's (VK2BDN) location was on Mt. Conoblas overlooking Orange. The gear, which was 90 per cent. home brew, consisted of two 4 ft. 6 in. parabolic dishes with 4-turn helix antennae to excite them. Bill's line up of gear included a f.m. 2 metre exciter (15 watts output) driving a veractor tripler to 432 MHz. and a veractor tripler to 1296 MHz. (output about 4 watts), the receiver being a crystal locked converter to a tunable i.f. at 14 MHz. with a f.m. detector. The gear used at VK2BDN's location included a f.m. 432 MHz. exciter running 13 watts output driving a veractor tripler to 1296 MHz. with 8 watts output, the receiver being a crystal locked converter into tunable i.f. with the first conversion at 144 MHz.

Although 16 miles does not appear to be any great increase in distance for this new record, anyone who has been to N.S.W. must realise the difficulty in finding a suitable path. However with 5 and 9 signals over the path of 149 miles, we are looking at a path which will give us 220 miles.—VK2BDN.

☆

W.I.A. COOK BI-CENTENARY AWARD

It is with great pleasure that we announce the following recipients:—

Certificate No. 1—
E. J. Kenny, ZM2QK (first world-wide).

Certificate No. 2—
H. G. Wilson, AX2AGO (first Australian).

Interest in the Award has exceeded all expectations and it has been most encouraging to hear the very friendly spirit among the stations working towards the Award.

—Geoff Wilson, AX3AMK,
Federal Awards Manager.

— . . . —

WORKED NORTH QUEENSLAND AWARD

RULES

1. The award is available to any licensed Amateur who is able to confirm contact with five Amateur Stations in North Queensland.

2. North Queensland is defined as that part of the State of Queensland North in latitude of Sarina and includes such cities as Mackay, Ayr, Townsville, Charters Towers, Mt. Isa and Cairns.

3. Confirmation is required in the form of QSL cards or a check list, the accuracy of which is confirmed by an executive officer of a Radio Club or Society.

4. The Townsville Amateur Radio Club is the sponsor of the award. Any queries relating to the award will be resolved solely by the Club.

5. A handsome multicolour certificate will be sent to those who apply and qualify for the award.

6. Applications should be addressed to—

The Secretary,
Townsville Amateur Radio Club,
P.O. Box 964,
Townsville, Qld., 4810.

AMATEUR FREQUENCIES:
ONLY THE STRONG GO ON—
SO SHOULD A LOT MORE
AMATEURS!

DX

Sub-Editor: DON GRANTLEY
P.O. Box 222, Penrith, N.S.W., 2750
(All times in GMT)

From George Studd, ZL2AFZ, DX editor for the N.Z.A.R.T., comes news of the stations for which he is QSL manager. Firstly, ZM1AAT/K is now active on all bands following the mishap to his transceiver, however he has had to change frequencies to 7010 and 3510 due to heavy QRM. Inward QSLs are being cleared by return mail. ZM3PO/C is active but cannot give a regular time of operation due to shift commitments. His cards will be delayed while a new batch is printed. Finally, Barry ZM1BN/A will be active by the time this reaches press, he has been troubled by equipment faults.

I would like to thank George for regularly mailing notes to us, they are full of information and of course a real asset to me in compiling. His QTH for stations under his management is: G. Studd, ZM2AFZ, 48 Nuffield Ave., Napier, N.Z. In passing, George is one of the best c.w. operators in the world. I remember one occasion a few years ago when he was in contact with a KG6, I think it was either KG6IJ or KG6IG, when the other end of the contact was testing out an electronic keyer. The longer they went the faster they went, finally they left me at a speed where I was forced to leave the pencil and take to the typewriter, finally in order to copy the QSO I had to record it at 7 i.p.c. on tape, and replay at 3¾ i.p.s. Even at that it was still faster than normal. Best QSO I have ever heard.

It is expected that there will be a DX-pedition to Hasselwood Rock near Rockall Is. in the Outer Hebrides by DL5YT in May 1970, and there is a strong possibility of D.X.C.C. credit for this one.

Band conditions have been steady for this month, with some good DX on the lower bands, particularly 80 metres. George Allen over in Perth logged about 19 prefixes including GD3TXF, G3, JA1, SM7, UA0, PK1, DJ5 and OH2 one night a few weeks ago, whilst the following are reported as worked from ZL: G, ON4, HB9, GC3, CP1, TI, VE6, W9, K6/3/0/5/9, PJ0, LU2, KX6 and many others. The frequencies given are all in the s.s.b. segment, and times range from 0600 to 1200z.

On 40 metres, similar conditions prevail, with good openings to most parts of the world, and to all W call areas. The commercials in the c.w. segment make copy difficult, but nevertheless, there is activity there.

There has been a couple of good openings on 160 metres, these being reported by George Allen who heard the Europeans on this band at around 2100z. G3IGW and G3RPB are involved in the skeds, and also some DLs have been heard. This is too late for the Eastern States, as the sun is high at that time and of course we must have a dark path for 160 metre DX.

The main DX bands have been mainly good, 20 has occasional flat periods, but on the whole has been outstanding, with good openings on 15 and decreasing activity on 10.

There will have been activity from Albania by the time you read this. ZA1BA from the Tirana Technical High School was due on early December for 10 days. QTH C/o. P.O. Tirana.

VP2AA has been reported on 15 metres at 2250z, name Barney, new QSL address is Box 46, St. John, Antigua.

W2KGO/MM was heard here during the Apollo 12 jaunt, he is the station operating from USS Hornet, the rescue ship for the astronaughts. We understand that he has a special QSL.

QSL information for EA6BG on Balearic Island is W1RLV for American stations only, DL7FT for the rest of the world. The station has been working 21320 at around 1230z.

I mentioned earlier in these notes that Rockall Is. may get D.X.C.C. credit, according to the LIDXA bulletin the A.R.R.L. have now granted this, and state that the R.A.F. may use a helicopter to fly a DX-pedition there this year.

VP2EQ is a new station operating from Anguilla, reported by Bernard Hughes of the ISWL. He is active daily on 14180 at about 1900z. QSLs go to British Amateur Radio Station, B.F.P.O. 643, London. Should be there until end of February.

The following information has been received by Stew Foster, DX editor of Monitor from K9CSM, who states that he has been instructed by the stations for whom he is manager to QSL only when the QSL or report is accompanied by SASE or IRCs. The stations for whom he is manager are 9V1OI, 9V1OX, MP4BGR, MP4BGW, MP4BGY, 9K2CA, 9K2CB, 9K2CC and SV0WM. States that he cannot use the bureau.

Recently a station was active calling himself 7G1CG, however he was not located officially in the Republic of Guinea, therefore is regarded as illegial.

Here is the latest list of YB prefixes. YB0, City of Djakarta; YB1, West Java; YB2, Central Java; YB3, East Java; YB4, South Sumatra; YB5, Central Sumatra; YB6, North Sumatra; YB7, Borneo Is. or Kalimantam as it is known; YB8, Celebes; YB9 covers all islands east of Java, including Irian Barat.

Now one for the SWLs. Since the cessation of the SWL page here in "A.R.," the question of QSL ladder positions for VK SWLs often crops up. I try to keep a record here, and would be pleased to here occasionally from active listeners as to their scores. Number of countries heard/confirmed/zones confirmed, and American states confirmed. The top positions as far as I can ascertain at present in order of countries confirmed are Eric Trebilcock, Peter Drew, Ernie Luff who has just passed the 200 mark with myself fourth on 197.

Another award of interest is the Mercury Award. This covers QSOs and reports since October 1, 1960, with members of the Royal Navy Amateur Radio Society. The basic requirement is for 20 points for U.K. stations, 10 for other Europeans, and we here in Australia need only 5 points for the award in its basic form. Each member counts as one point, with HQ station G3BZU or G3BRN counting as two points. Stations can be worked for additional points on another band or mode. Stickers are issued for each additional point over basic requirement. CHC rules apply, fee is 2/6 sterling or 5 IRCs. Certified list to the custodian, G3HZL, 153 Worple Rd., Isleworth, Middlesex, England.

At this stage we will continue with QSL information, which will fill out the remainder of this issue. First of all I have full information on the C31 stations QSL managers: C31BC F9IE, BD F9JS, BL F3KT, BS ON5FD, BT F5JB, CA F2PY, CD DL6SZ, CE HB9UP, CH F8YY, CJ F1XM, CI HG9SJ, CK W7GVA, CL K7ADD, CM F9ET, CN F8VQ.

QTH SECTION

DU1BEN—Box 370, Manila, Philippine Is.
DU7GB—Box 15, San Carlos, P.I.
EA8GA—Cas 215, Tenerife, Canary Is.
EA9EJ—Justo Benedicto Perez, Cas 172, El Aaiun, Spanish Sahara.
EA9ER—Angel Cuervo, Cas 227, El Aaiun.
HC8GS—Lucio Saltos, Santa Cruz, Islas Galapagos, Ecuador.
JT1AK—Box 92, Ulan Bator, Mongolia.
KA9ZZ—Box 573, A.P.O., San Francisco, Calif., U.S.A., 96281.
KJ6CF—P.M.R., Box 141, A.P.O., San Francisco, Calif., U.S.A., 96305.
KM6BI—R. McCormick, A.R.S. KM6BI, F.P.O., San Francisco, Calif., U.S.A., 96614.
KV4AD—Box 2126, St. Thomas U.S., Virgin Is., 00801.
MP4TCQ—J. Hammond, Radio Troop, 222 Sig. Sqn., B.F.P.O., 64, London.
PZ1BI—Box 1810, Moengo, Surinane, South America.
TT8AF—B.P. 444, Fort Lamy, Republic of Tchad, Africa.
VP1CP—B.P.X. 584, Belize, British Honduras, Cent. America.
VQ8CR—R. Mills, C/o. Admiralty Office, Vacaos, Mauritius.
VQ8CU—Box 13562, Tampa, Florida, U.S.A., 33611.
YA1AB—Box 76, Kabul, Afghanistan.
YA2HWI—Box 638, Kabul.
4J0FR—Box 88, Central Radio Club, Moscow.
4L0CR—Box 88, Moscow.
6O1KM—Box 948, Mogadiscio, Somali Republic, Africa.
9Q5EA—Box 76, Kapanga, Republic of Congo, Africa.
9V0OX—Box 2964, Singapore.

The foregoing by courtesy of the ISWL, London.

As these notes are more or less a fill in during the holidays, they are of necessity short. Normal notes will resume with the next issue. I am very grateful for the number who have taken the trouble to write, ring or tape with various notes and comments, these being essential to the smooth running of any such project. I look forward to your continued support for the new year.

Acknowledgment of copy for this issue to George Allen, George Studd, ZL2AFZ; Stewart Foster and Bernard Hughes, of the ISWL; Geoff Watts, DX News Sheet; LIDXA, Steve Ruedigef, and Mac Hilliard. 73 and good DX, de Don WIA-L2022.

CONTEST CALENDAR

7th/8th February: John M. Moyle National Field Day.

7th/8th February: 36th A.R.R.L. International DX Competition (1st phone).

21st/22nd February: 36th A.R.R.L. International DX Competition (1st c.w.).

28th Feb./15th March: I.A.R.C. Propagation Research Competition (c.w./r.t.t.y. section).

7th/8th March: 36th A.R.R.L. International DX Competition (2nd phone).

15th March/19th April: Propagation Research Competition (phone section).

21st/22nd March: 36th A.R.R.L. International DX Competition (2nd c.w.).

15th/16th August: Remembrance Day Contest.

3rd/4th October: VK-ZL-Oceania DX Contest—phone.

10th/11th October: VK-ZL-Oceania DX Contest—c.w.

5th Dec./11th Jan. 1971: Ross A. Hull V.h.f. Memorial Contest.

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PROVISIONAL SUNSPOT NUMBERS

NOVEMBER 1969

Dependent on observations at Zurich Observatory and its stations in Locarno and Arosa.

Day	R	Day	R
1	78	16	67
2	60	17	69
3	78	18	80
4	79	19	91
5	83	20	120
6	95	21	121
7	86	22	130
8	79	23	117
9	89	24	103
10	66	25	118
11	75	26	112
12	68	27	109
13	61	28	102
14	60	29	85
15	68	30	85

Mean equals 87.8.

Smoothed Mean for May 1969: 103.2.

DECEMBER 1969

Day	R	Day	R
1	91	16	86
2	107	17	98
3	93	18	85
4	90	19	76
5	78	20	90
6	66	21	112
7	46	22	125
8	39	23	113
9	44	24	127
10	37	25	149
11	27	26	131
12	51	27	136
13	74	28	139
14	94	29	152
15	83	30	152
		31	116

Mean equals 93.8.

Smoothed Mean for June 1969: 102.6.

Predictions of the Smoothed Monthly Sunspot Numbers

January	89	April	83
February	87	May	82
March	85	June	81

—Swiss Federal Observatory, Zurich.

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ANNUAL ZL FIELD DAY

When: 0300 to 1200 GMT, Saturday, 14th Feb. and 1800 GMT Saturday, to 0300 GMT Sunday, 15th Feb.

Object: To contact as many portable and mobile ZL/ZM stations as possible on phone and c.w.

Bands: 40 and 80 metres only.

Exchanges: VKs to give RS(T) plus QSO number starting from 001. ZL/ZMs will give a similar number plus their Branch number: e.g. 579024/11.

Scoring: Claim 3 points for each phone contact and 5 points for each c.w. contact. Multiply the total points from both bands by the sum of the Branches worked on each band, each mode. (i.e. the one Branch can be claimed as a multiplier four times).

Post logs to ZL2GZ, 152 Lytton Road, Gisborne, New Zealand, as soon as possible. Certificates will be awarded to the top VK in each district.

FEEDBACK

The Federal Contest Committee wish to advise the following corrections to results of recent W.I.A. Contests.

1969 NATIONAL FIELD DAY

Receiving (Section F)

6-Hour Division

Delete L-5096, T. Hannaford, 1015 points. Certificate winner now becomes L-5015, W. Clayson, 189 points.

24-Hour Division

Add L-5096, T. Hannaford, 1015 points, who becomes winner of this section.

1969 R.D. CONTEST

Divisional Scores

Delete the table of Divisional Scores and replace with the following—

Division	Log Entry	Licensees	Participation
VK2+1+9	111	1,972	5.6%
VK3	80	1,785	4.5%
VK4+9	80	752	10.6%
VK5+8	89	769	11.6%
VK6+9	56	436	12.8%
VK7	59	238	24.8%

Division	Av. Top 6 Logs	Total State Points	State Score
VK2+1+9	1,120	33,000	2,986
VK3	781	20,800	1,713
VK4+9	1,277	26,053	4,049
VK5+8	1,106	25,337	4,038
VK6+9	918	17,270	3,136
VK7	1,068	15,806	4,986

New South Wales

Transmitting Phone—Section (a):
VK2BNA's score to read 1,116 points—not 116.

Victoria

Transmitting Phone—Section (a):
Delete VK3OP, 327 points.

Transmitting C.W.—Section (b):
Add VK3OP, 327 points.

VK3OP now becomes the leader in this section.

Analysis of R.D. Results

Revised list of top six logs for VK2 and VK5—

VK2ASZ	1256 points
2BO	1173 "
2BNA	1116 "
1JG	1105 "
2XT	1054 "
2AD	1015 "
VK5GW	1172 points
5FO	1167 "
5FT	1160 "
5NN	1103 "
5BI	1039 "
5KG	995 "

None of the above alterations affect the overall winner of the 1969 Contest. Tasmania remains the winner by a somewhat greater margin than was first published, but the difference between second and third placegetters, VK4 and VK5, has been lessened.

The Federal Contest Committee regret any inconvenience that the above alterations may cause and apologise to those concerned. Despite all precautions errors do slip by and this time Murphy won hands down.

SILENT KEYS

It is with deep regret that we record the passing of—

VK2BA—Bruce Chapman
Ex-VK2ZK—A. G. Henry
VK3EW—Eric Wheller
VK3AWO—Arthur Oakes
VK6ZBG—Cyril Baker
VK7PA—A. E. Allen

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EXCHANGE: BC221 Frequency Meter for decent Receiver. 64 O'Grady Street, Albert Park, Vic., 3206.

FOR SALE: Byer "66" Tape Recorder complete with tuner and new full track heads. The machine has been completely overhauled and is in excellent condition, complete with accessories, $450. Sennheiser (new) Mic. MD21/2, complete with transformer and table stand, $40. J. W. Nairn, P.O. Box 432, Traralgon, Vic., 3844.

FOR SALE: One MR10A Carphone, complete with all cables and Channel A xtals, $35 or best offer. Contact Howard Anders, VK3AYV, Phone 277-1207 after hours.

FOR SALE: Hallicrafters VFO, perfect, all bands 2-80 mx. Eico Tx 90w., built-in ant. relay, matching network, etc., 10-80 mx. Together $150 or best offer. Power Chokes 15 H. 150 mA., 30 H. 80 mA., $1.50 each. Schoning, G.P.O. Box 392, Sydney, N.S.W., 2001. Phone 602-0333 Ext. 318.

FOR SALE: Heathkit "Mohican" GC-1A solid state Rx, 450 KHz. to 32.0 MHz., $100 o.n.o. H. P. Trutmann, VK3HV, 7 Nerita Gdns., Corio, Vic., 3214. Phone 79111 office hours or 78404 after 5 p.m. or week-ends.

FOR SALE: Lafayette HA600 Transistor Communications Receiver, coverage 150 KHz. to 10 MHz., bandspread on Amateur frequencies, condition as new, $140. Will trade VHF gear. J. Oliver, 73 Normanstone Rd., Launceston, Tas., 7250. VK7JO.

FOR SALE: MR3A Carphone Junior, 2 mx FM Transceiver, $40. Commercial appearance H.B. 80-10 mx SSB-AM Tx, 200w. p.e.p., 9 MHz. McCoy filter, 8236 PA, cost $350, sell $150 o.n.o. VK3ZX, Phone Traralgon 73135.

FOR SALE: Trio 9R-59D Communications Receiver. As new condition, features an in-built 3.5 MHz. crystal calibrator and bandspread for all Ham bands. $160.00. Contact VK3ZZY at 50-4367 after hours.

FOR SALE: Type TAA300 Integrated Circuit Audio Amplifiers, 1 watt r.m.s. out with 8.5 mV. in, 8-15 ohm load, $3.15 each including data, circuit. Write or call VK5ZRN, 24 Gulfview Road, Blackwood, S.A., 5051.

FOR SALE until 20/3/70: 25w. 2 mx AM Tx-Rx, $140. ATR2B Transceiver, complete, $50. Hallicrafters SX17A, $150. Eddystone 888A, new, $200. 150w. H.B. 5-band Transmitter, $75. 50w. DSB 6-band Transmitter, $55. 52.525 MHz. FM Receiver, $15. 60-100 MHz. AM/FM SWL-ZC-Receiver, $18. 150w. high power 2 mx Tx-Modulator, xtal-VFO, complete, $200. 7-band A.W.A. 617TZ Receiver, $45. 6 mx 15w. AM Base Stations, $45. 2 mx 146 MHz. FM Vintens, $45. MR10C 146 MHz., $50. MR3A 52.525 MHz. AC/DC, $60. Pye 734 LB AM Base Stations, $50 each. For further details and complete listing of unconverted HB/LB AM/FM Carphones, send SAE to 31 Donald Street, Morwell, Vic., Phone 43953.

FOR SALE: Yaesu FL50 Transmitter, complete with External VFO, $165. Pye Ranger Carphone, complete with xtals on 53.032 MHz. net, $35. 50-foot Triangular Telescopic Tower, $55. Inspection invited. Mike Trickett, VK3ASQ, 8 Matlock St., Herne Hill, Geelong, Vic. Phone 71886.

FOR SALE: (1) Heathkit Transmitter DX100B, 150w., par. 6146, mod. class B, modified differential keying; also for use with Heath SSB Adaptor Model SB10, 110v./240v. a.c. operated, freq. 160 mx to 10 mx including 27 MHz., 7 bands, VFO or Xtal, spares included, $150. (2) Heath SB10 SSB Adaptor, 9 valves, 10w. p.e.p. AM USB/LSB, Vox, manual, mod. for p.t.t., spares included, $90. Above items are in excellent condition and are used on air as an SSB combination. Manuals, wiring diagrams, and modification articles, data and connecting cables are included. (3) Johnson Matchbox, 275 watts, as new, in orig. carton, complete with instructions and diagrams, $90. (4) Channelmaster Beam Rotator, 240v. a.c./24v. operation, complete 60 feet approx. 3-wire control cable and indicator control box, working and good condition, $50. George Manning, VK3XJ, P.O. Box 46, Birchip, Vic. (Phone 9).

HRO-60 Receiver, SSB/AM/CW, 1.7 to 30 MHz. General coverage and/or Ham Bands only. Your chance to own one of the greatest communications Receivers at a reasonable price. $695.00. VK3TD, Phone 783-9611 or 787-1407 (after hours).

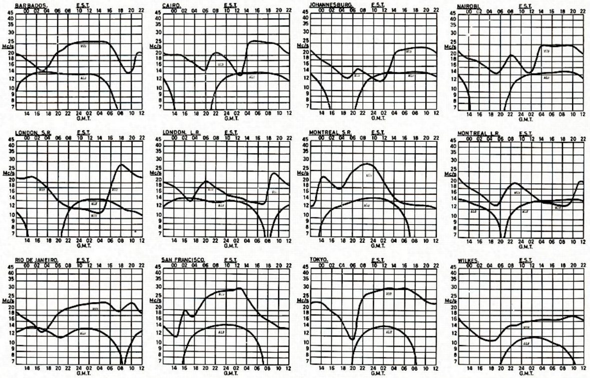
WANTED: Triband Beam (any condition), also Rotator wanted. Have 2 element 10 mx Beam with Balun. Accept reasonable offer. Have 4 element 6 mx Beam. Accept reasonable offer. Ian Dunlop, VK2AVS, 7 James St., Murwillumbah, N.S.W., 2484.

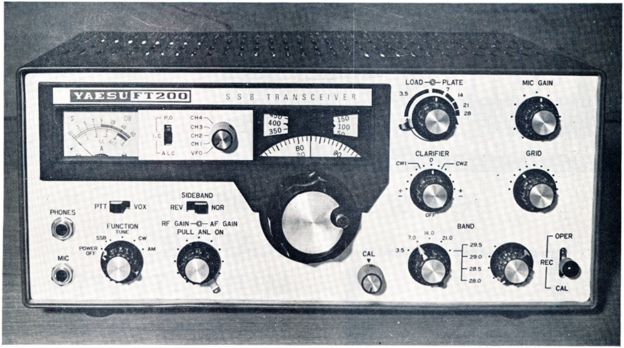
WEBSTER Band Spanner Mobile Antenna. 10-80 mx new, $30. Webster Model 3400F De Luxe Marine Antenna, extends to 26 ft., $45. 240 watt SSB Transceiver, 10/20/40/80 metre bands, less power supply, $180. 1000 volt 250 mA. Power Supply for above Transceiver, $100. VK3TD, Cassiobury Ave., Mt. Eliza, Vic. Phone 783-9611 (office), 787-1407 (after hours).

200 WATT, 4-band SSB Transceiver chassis, suitable conversion to Ham Bands, $30. 800 watt Linear Amplifier partially built, all parts including pair of 811 tubes and Power Supply, $99. VK3TD. Phone 783-9611 or 787-1407 (after hours).

PREDICTION CHARTS FOR FEBRUARY 1970

(Prediction Charts by courtesy of Ionospheric Prediction Service)





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